

D-68445

2015-07-27

Systems Engineering & Formulation Division

Project Ontology

Integrated Model-Centric Engineering



National Aeronautics and Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

Copyright © 2013 California Institute of Technology.

Government sponsorship acknowledged.

This research was carried out at the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.

Contents

1	Introduction	1
2	Imported Ontologies	3
3	Namespaces	5
4	Abstract Class Definitions	9
4.1	AssignedElement	9
4.2	DevelopedElement	9
4.3	RealizedElement	9
4.4	SuppliedElement	13
5	Concrete Class Definitions	15
5.1	Authority	15
5.2	Concern	18
5.3	Deliverable	18
5.4	DevelopmentState	21
5.5	Facility	22
5.6	Interchange	24
5.7	Organization	26
5.8	Person	27
5.9	Policy	29
5.10	Process	32
5.11	Product	34
5.12	Program	35
5.13	Project	37
5.14	Role	39
5.15	Stakeholder	41
5.16	WorkPackage	43
6	Object Property Reification Class Definitions	47
6.1	Approves	47
6.2	Authorizes	47
6.3	BelongsTo	49
6.4	Binds	50
6.5	Concurs	50
6.6	DelegatesTo	52
6.7	Delivers	54
6.8	Describes	58
6.9	Executes	58
6.10	HasAssignment	60
6.11	HasParticipant	62
6.12	HasResponsibilityFor	65
6.13	HasRole	65
6.14	Invokes	66
6.15	Involves	68
6.16	Involves1	70

6.17	Involves2	70
6.18	Manifests	72
6.19	Prepares	73
6.20	Produces	75
6.21	Realizes	78
6.22	Receives	78
6.23	ReliesOn	80
6.24	Represents	81
6.25	Supplies	84
7	Concrete Datatype Property Definitions	87
7.1	isRequiredNotLaterThan	87
8	Abstract Object Property Definitions	89
8.1	involves	89
8.2	isInvolvedIn	89
9	Concrete Object Property Definitions	91
9.1	approves	91
9.2	authorizes	91
9.3	belongsTo	91
9.4	binds	92
9.5	concurr	94
9.6	delegatesTo	94
9.7	delivers	95
9.8	describes	95
9.9	executes	96
9.10	hasAssignment	97
9.11	hasParticipant	97
9.12	hasResponsibilityFor	97
9.13	hasRole	99
9.14	invokes	99
9.15	involves1	100
9.16	involves2	101
9.17	isApprovedBy	101
9.18	isAssignedTo	102
9.19	isBoundBy	102
9.20	isConcurredBy	102
9.21	isDelegateOf	105
9.22	isDeliveredBy	105
9.23	isDescribedBy	106
9.24	isExecutedBy	106
9.25	isInvokedBy	107
9.26	isInvolvedIn1	107
9.27	isInvolvedIn2	108
9.28	isManifestedBy	108
9.29	isPreparedBy	108
9.30	isProducedBy	109

9.30.1	Comments	110
9.31	isRealizedBy	110
9.32	isReceivedBy	110
9.33	isReliedOnBy	110
9.34	isRepresentedBy	112
9.35	isResponsibilityOf	113
9.36	isRoleOf	113
9.37	isSuppliedBy	114
9.38	manifests	114
9.39	participatesIn	115
9.40	prepares	115
9.41	produces	116
9.41.1	Comments	116
9.42	realizes	116
9.43	receives	117
9.44	reliesOn	117
9.45	represents	119
9.46	supplies	119
10	Object Property Reification Source/Target Object Property Definitions	121
10.1	hasApprovesSource	121
10.2	hasApprovesTarget	121
10.3	hasAuthorizesSource	121
10.4	hasAuthorizesTarget	121
10.5	hasBelongsToSource	122
10.6	hasBelongsToTarget	122
10.7	hasBindsSource	122
10.8	hasBindsTarget	122
10.9	hasConcursSource	123
10.10	hasConcursTarget	123
10.11	hasDelegatesToSource	123
10.12	hasDelegatesToTarget	123
10.13	hasDeliversSource	124
10.14	hasDeliversTarget	124
10.15	hasDescribesSource	124
10.16	hasDescribesTarget	124
10.17	hasExecutesSource	124
10.18	hasExecutesTarget	125
10.19	hasHasAssignmentSource	125
10.20	hasHasAssignmentTarget	125
10.21	hasHasParticipantSource	125
10.22	hasHasParticipantTarget	125
10.23	hasHasResponsibilityForSource	126
10.24	hasHasResponsibilityForTarget	126
10.25	hasHasRoleSource	126
10.26	hasHasRoleTarget	126
10.27	hasInvokesSource	126
10.28	hasInvokesTarget	127

10.29hasInvolves1Source	127
10.30hasInvolves1Target	127
10.31hasInvolves2Source	127
10.32hasInvolves2Target	128
10.33hasInvolvesSource	128
10.34hasInvolvesTarget	128
10.35hasManifestsSource	128
10.36hasManifestsTarget	129
10.37hasPreparesSource	129
10.38hasPreparesTarget	129
10.39hasProducesSource	129
10.40hasProducesTarget	130
10.41hasRealizesSource	130
10.42hasRealizesTarget	130
10.43hasReceivesSource	130
10.44hasReceivesTarget	131
10.45hasReliesOnSource	131
10.46hasReliesOnTarget	131
10.47hasRepresentsSource	131
10.48hasRepresentsTarget	131
10.49hasSuppliesSource	132
10.50hasSuppliesTarget	132
A UML/SysML Embedding	133
Index	137

List of Figures

1	Class definition diagram for AssignedElement.	10
2	Class definition diagram for DevelopedElement.	11
3	Class definition diagram for RealizedElement.	12
4	Class definition diagram for SuppliedElement.	13
5	Class definition diagram for Authority.	16
6	Class usage diagram for Authority.	17
7	Class definition diagram for Concern.	19
8	Class usage diagram for Concern.	19
9	Class definition diagram for Deliverable.	20
10	Class usage diagram for Deliverable.	21
11	Class definition diagram for DevelopmentState.	22
12	Class usage diagram for DevelopmentState.	23
13	Class definition diagram for Facility.	24
14	Class usage diagram for Facility.	25
15	Class definition diagram for Interchange.	26
16	Class usage diagram for Interchange.	27
17	Class definition diagram for Organization.	28
18	Class usage diagram for Organization.	28
19	Class definition diagram for Person.	29
20	Class usage diagram for Person.	30
21	Class definition diagram for Policy.	30
22	Class usage diagram for Policy.	31
23	Class definition diagram for Process.	33
24	Class usage diagram for Process.	33
25	Class definition diagram for Product.	35
26	Class usage diagram for Product.	36
27	Class definition diagram for Program.	37
28	Class usage diagram for Program.	38
29	Class definition diagram for Project.	39
30	Class usage diagram for Project.	40
31	Class definition diagram for Role.	41
32	Class usage diagram for Role.	42
33	Class definition diagram for Stakeholder.	43
34	Class usage diagram for Stakeholder.	44
35	Class definition diagram for WorkPackage.	45
36	Class usage diagram for WorkPackage.	45
37	Class definition diagram for Approves.	47
38	Class usage diagram for Approves.	48
39	Class definition diagram for Authorizes.	49
40	Class usage diagram for Authorizes.	50
41	Class definition diagram for BelongsTo.	51
42	Class usage diagram for BelongsTo.	51
43	Class definition diagram for Binds.	52
44	Class usage diagram for Binds.	53
45	Class definition diagram for Concurr.	54
46	Class usage diagram for Concurr.	55

47	Class definition diagram for DelegatesTo.	56
48	Class usage diagram for DelegatesTo.	56
49	Class definition diagram for Delivers.	57
50	Class usage diagram for Delivers.	57
51	Class definition diagram for Describes.	58
52	Class usage diagram for Describes.	59
53	Class definition diagram for Executes.	60
54	Class usage diagram for Executes.	61
55	Class definition diagram for HasAssignment.	62
56	Class usage diagram for HasAssignment.	63
57	Class definition diagram for HasParticipant.	64
58	Class usage diagram for HasParticipant.	64
59	Class definition diagram for HasResponsibilityFor.	65
60	Class usage diagram for HasResponsibilityFor.	66
61	Class definition diagram for HasRole.	67
62	Class usage diagram for HasRole.	67
63	Class definition diagram for Invokes.	68
64	Class usage diagram for Invokes.	69
65	Class definition diagram for Involves.	69
66	Class usage diagram for Involves.	70
67	Class definition diagram for Involves1.	71
68	Class usage diagram for Involves1.	71
69	Class definition diagram for Involves2.	72
70	Class usage diagram for Involves2.	73
71	Class definition diagram for Manifests.	74
72	Class usage diagram for Manifests.	74
73	Class definition diagram for Prepares.	75
74	Class usage diagram for Prepares.	76
75	Class definition diagram for Produces.	77
76	Class usage diagram for Produces.	77
77	Class definition diagram for Realizes.	78
78	Class usage diagram for Realizes.	79
79	Class definition diagram for Receives.	80
80	Class usage diagram for Receives.	81
81	Class definition diagram for ReliesOn.	82
82	Class usage diagram for ReliesOn.	82
83	Class definition diagram for Represents.	83
84	Class usage diagram for Represents.	83
85	Class definition diagram for Supplies.	84
86	Class usage diagram for Supplies.	85
87	Property usage diagram for approves.	91
88	Property usage diagram for authorizes.	92
89	Property usage diagram for belongsTo.	92
90	Property usage diagram for binds.	93
91	Property usage diagram for concurs.	94
92	Property usage diagram for delegatesTo.	95
93	Property usage diagram for delivers.	95
94	Property usage diagram for describes.	96

95	Property usage diagram for executes.	96
96	Property usage diagram for hasAssignment.	98
97	Property usage diagram for hasParticipant.	98
98	Property usage diagram for hasResponsibilityFor.	99
99	Property usage diagram for hasRole.	99
100	Property usage diagram for invokes.	100
101	Property usage diagram for involves1.	100
102	Property usage diagram for involves2.	101
103	Property usage diagram for isApprovedBy.	101
104	Property usage diagram for isAssignedTo.	103
105	Property usage diagram for isBoundBy.	104
106	Property usage diagram for isConcurredBy.	104
107	Property usage diagram for isDelegateOf.	105
108	Property usage diagram for isDeliveredBy.	105
109	Property usage diagram for isDescribedBy.	106
110	Property usage diagram for isExecutedBy.	107
111	Property usage diagram for isInvokedBy.	107
112	Property usage diagram for isInvolvedIn1.	108
113	Property usage diagram for isInvolvedIn2.	108
114	Property usage diagram for isManifestedBy.	109
115	Property usage diagram for isPreparedBy.	109
116	Property usage diagram for isProducedBy.	110
117	Property usage diagram for isRealizedBy.	111
118	Property usage diagram for isReceivedBy.	112
119	Property usage diagram for isReliedOnBy.	112
120	Property usage diagram for isRepresentedBy.	112
121	Property usage diagram for isResponsibilityOf.	113
122	Property usage diagram for isRoleOf.	113
123	Property usage diagram for isSuppliedBy.	114
124	Property usage diagram for manifests.	115
125	Property usage diagram for participatesIn.	115
126	Property usage diagram for prepares.	116
127	Property usage diagram for produces.	116
128	Property usage diagram for realizes.	118
129	Property usage diagram for receives.	118
130	Property usage diagram for reliesOn.	119
131	Property usage diagram for represents.	119
132	Property usage diagram for supplies.	120

List of Tables

1	Class UML/SysML Embedding	133
2	Class OWL2-MOF2 Embedding	134
3	Object Property Reification Class OWL2-MOF2 Embedding	135

1 Introduction

The Project Ontology defines concepts and properties for describing a project in terms of its stakeholders, concerns, work breakdown, and deliverables. It provides a basis for specialization by domain experts.

2 Imported Ontologies

- <http://imce.jpl.nasa.gov/foundation/analysis/analysis>
- <http://imce.jpl.nasa.gov/discipline/mechanical/mechanical>

3 Namespaces

Metrology <http://imce.jpl.nasa.gov/www.omg.org/spec/SysML/20140311/Metrology#>

Metrology-backbone <http://imce.jpl.nasa.gov/backbone/imce.jpl.nasa.gov/www.omg.org/spec/SysML/20140311/Metrology#>

Metrology-metamodel <http://imce.jpl.nasa.gov/www.omg.org/spec/SysML/20140311/Metrology-metamodel#>

Metrology-metamodel-backbone <http://imce.jpl.nasa.gov/backbone/imce.jpl.nasa.gov/www.omg.org/spec/SysML/20140311/Metrology-metamodel#>

PrimitiveTypes <http://imce.jpl.nasa.gov/www.omg.org/spec/PrimitiveTypes/20110701/PrimitiveTypes#>

PrimitiveTypes-backbone <http://imce.jpl.nasa.gov/backbone/imce.jpl.nasa.gov/www.omg.org/spec/PrimitiveTypes/20110701/PrimitiveTypes#>

PrimitiveTypes-metamodel <http://imce.jpl.nasa.gov/www.omg.org/spec/PrimitiveTypes/20110701/PrimitiveTypes-metamodel#>

PrimitiveTypes-metamodel-backbone <http://imce.jpl.nasa.gov/backbone/imce.jpl.nasa.gov/www.omg.org/spec/PrimitiveTypes/20110701/PrimitiveTypes-metamodel#>

QUDV <http://imce.jpl.nasa.gov/www.omg.org/spec/SysML/20140311/QUDV#>

QUDV-backbone <http://imce.jpl.nasa.gov/backbone/imce.jpl.nasa.gov/www.omg.org/spec/SysML/20140311/QUDV#>

QUDV-metamodel <http://imce.jpl.nasa.gov/www.omg.org/spec/SysML/20140311/QUDV-metamodel#>

QUDV-metamodel-backbone <http://imce.jpl.nasa.gov/backbone/imce.jpl.nasa.gov/www.omg.org/spec/SysML/20140311/QUDV-metamodel#>

StandardProfileL2 <http://imce.jpl.nasa.gov/www.omg.org/spec/UML/20110701/StandardProfileL2#>

StandardProfileL2-backbone <http://imce.jpl.nasa.gov/backbone/imce.jpl.nasa.gov/www.omg.org/spec/UML/20110701/StandardProfileL2#>

StandardProfileL2-metamodel <http://imce.jpl.nasa.gov/www.omg.org/spec/UML/20110701/StandardProfileL2-metamodel#>

StandardProfileL2-metamodel-backbone <http://imce.jpl.nasa.gov/backbone/imce.jpl.nasa.gov/www.omg.org/spec/UML/20110701/StandardProfileL2-metamodel#>

SysML <http://imce.jpl.nasa.gov/www.omg.org/spec/SysML/20140311/SysML#>

SysML-backbone <http://imce.jpl.nasa.gov/backbone/imce.jpl.nasa.gov/www.omg.org/spec/SysML/20140311/SysML#>

SysML-metamodel <http://imce.jpl.nasa.gov/www.omg.org/spec/SysML/20140311/SysML-metamodel#>

SysML-metamodel-backbone <http://imce.jpl.nasa.gov/backbone/imce.jpl.nasa.gov/www.omg.org/spec/SysML/20140311/SysML-metamodel#>

UML <http://imce.jpl.nasa.gov/www.omg.org/spec/UML/20110701/UML#>

UML-backbone <http://imce.jpl.nasa.gov/backbone/imce.jpl.nasa.gov/www.omg.org/spec/UML/20110701/UML#>

UML-metamodel <http://imce.jpl.nasa.gov/www.omg.org/spec/UML/20110701/UML-metamodel#>

UML-metamodel-backbone <http://imce.jpl.nasa.gov/backbone/imce.jpl.nasa.gov/www.omg.org/spec/UML/20110701/UML-metamodel#>

analysis <http://imce.jpl.nasa.gov/foundation/analysis/analysis#>

analysis-backbone <http://imce.jpl.nasa.gov/backbone/imce.jpl.nasa.gov/foundation/analysis/analysis#>

analysis-embedding <http://imce.jpl.nasa.gov/foundation/analysis/analysis-embedding#>

analysis-embedding-backbone <http://imce.jpl.nasa.gov/backbone/imce.jpl.nasa.gov/foundation/analysis/analysis-embedding#>

annotation <http://imce.jpl.nasa.gov/foundation/annotation/annotation#>

annotation-backbone <http://imce.jpl.nasa.gov/backbone/imce.jpl.nasa.gov/foundation/annotation/annotation#>

architecture-framework <http://imce.jpl.nasa.gov/inactive/architecture-framework/architecture-framework#>

architecture-framework-backbone <http://imce.jpl.nasa.gov/backbone/imce.jpl.nasa.gov/inactive/architecture-framework/architecture-framework#>

architecture-framework-embedding <http://imce.jpl.nasa.gov/inactive/architecture-framework/architecture-framework-embedding#>

architecture-framework-embedding-backbone <http://imce.jpl.nasa.gov/backbone/imce.jpl.nasa.gov/inactive/architecture-framework/architecture-framework-embedding#>

base <http://imce.jpl.nasa.gov/foundation/base/base#>

base-backbone <http://imce.jpl.nasa.gov/backbone/imce.jpl.nasa.gov/foundation/base/base#>

base-embedding <http://imce.jpl.nasa.gov/foundation/base/base-embedding#>

base-embedding-backbone <http://imce.jpl.nasa.gov/backbone/imce.jpl.nasa.gov/foundation/base/base-embedding#>

behavior <http://imce.jpl.nasa.gov/foundation/behavior/behavior#>

behavior-backbone <http://imce.jpl.nasa.gov/backbone/imce.jpl.nasa.gov/foundation/behavior/behavior#>

behavior-embedding <http://imce.jpl.nasa.gov/foundation/behavior/behavior-embedding#>

behavior-embedding-backbone <http://imce.jpl.nasa.gov/backbone/imce.jpl.nasa.gov/foundation/behavior/behavior-embedding#>

behavior-view <http://imce.jpl.nasa.gov/foundation/behavior/behavior-view#>

behavior-view-backbone <http://imce.jpl.nasa.gov/backbone/imce.jpl.nasa.gov/foundation/behavior/behavior-view#>

data-view <http://www.w3.org/2003/g/data-view#>

data-view-backbone <http://imce.jpl.nasa.gov/backbone/www.w3.org/2003/g/data-view#>

dc <http://purl.org/dc/elements/1.1/>

dc-backbone <http://imce.jpl.nasa.gov/backbone/purl.org/dc/elements/1.1#>

mars-2020 <http://imce.jpl.nasa.gov/application/mars-2020/mars-2020#>

mars-2020-backbone <http://imce.jpl.nasa.gov/backbone/imce.jpl.nasa.gov/application/mars-2020/mars-2020#>

mars-2020-embedding <http://imce.jpl.nasa.gov/application/mars-2020/mars-2020-embedding#>

mars-2020-embedding-backbone <http://imce.jpl.nasa.gov/backbone/imce.jpl.nasa.gov/application/mars-2020/mars-2020-embedding#>

mechanical <http://imce.jpl.nasa.gov/discipline/mechanical/mechanical#>

mechanical-backbone <http://imce.jpl.nasa.gov/backbone/imce.jpl.nasa.gov/discipline/mechanical/mechanical#>

mechanical-embedding <http://imce.jpl.nasa.gov/discipline/mechanical/mechanical-embedding#>

mechanical-embedding-backbone <http://imce.jpl.nasa.gov/backbone/imce.jpl.nasa.gov/discipline/mechanical/mechanical-embedding#>

mission <http://imce.jpl.nasa.gov/foundation/mission/mission#>

mission-backbone <http://imce.jpl.nasa.gov/backbone/imce.jpl.nasa.gov/foundation/mission/mission#>

mission-embedding <http://imce.jpl.nasa.gov/foundation/mission/mission-embedding#>

mission-embedding-backbone <http://imce.jpl.nasa.gov/backbone/imce.jpl.nasa.gov/foundation/mission/mission-embedding#>

omf <http://imce.jpl.nasa.gov/foundation/omf/omf#>

omf-backbone <http://imce.jpl.nasa.gov/backbone/imce.jpl.nasa.gov/foundation/omf/omf#>

owl <http://www.w3.org/2002/07/owl#>

owl-backbone <http://imce.jpl.nasa.gov/backbone/www.w3.org/2002/07/owl#>

owl2-mof2 <http://imce.jpl.nasa.gov/foundation/owl2-mof2/owl2-mof2#>

owl2-mof2-backbone <http://imce.jpl.nasa.gov/backbone/imce.jpl.nasa.gov/foundation/owl2-mof2/owl2-mof2#>

owl2-mof2-embedding <http://imce.jpl.nasa.gov/foundation/owl2-mof2/owl2-mof2-embedding#>

owl2-mof2-embedding-backbone <http://imce.jpl.nasa.gov/backbone/imce.jpl.nasa.gov/foundation/owl2-mof2/owl2-mof2-embedding#>

project <http://imce.jpl.nasa.gov/foundation/project/project#>

project-backbone <http://imce.jpl.nasa.gov/backbone/imce.jpl.nasa.gov/foundation/project/project#>

project-embedding <http://imce.jpl.nasa.gov/foundation/project/project-embedding#>

project-embedding-backbone <http://imce.jpl.nasa.gov/backbone/imce.jpl.nasa.gov/foundation/project/project-embedding#>

rdf <http://www.w3.org/1999/02/22-rdf-syntax-ns#>

rdf-backbone <http://imce.jpl.nasa.gov/backbone/www.w3.org/1999/02/22-rdf-syntax-ns#>

rdfs <http://www.w3.org/2000/01/rdf-schema#>

rdfs-backbone <http://imce.jpl.nasa.gov/backbone/www.w3.org/2000/01/rdf-schema#>

risk <http://imce.jpl.nasa.gov/discipline/risk/risk#>

risk-backbone <http://imce.jpl.nasa.gov/backbone/imce.jpl.nasa.gov/discipline/risk/risk#>

risk-embedding <http://imce.jpl.nasa.gov/discipline/risk/risk-embedding#>

risk-embedding-backbone <http://imce.jpl.nasa.gov/backbone/imce.jpl.nasa.gov/discipline/risk/risk-embedding#>

state-analysis <http://imce.jpl.nasa.gov/discipline/state-analysis/state-analysis#>

state-analysis-backbone <http://imce.jpl.nasa.gov/backbone/imce.jpl.nasa.gov/discipline/state-analysis/state-analysis#>

state-analysis-embedding <http://imce.jpl.nasa.gov/discipline/state-analysis/state-analysis-embedding#>

state-analysis-embedding-backbone <http://imce.jpl.nasa.gov/backbone/imce.jpl.nasa.gov/discipline/state-analysis/state-analysis-embedding#>

swrl <http://www.w3.org/2003/11/swrl#>

swrl-backbone <http://imce.jpl.nasa.gov/backbone/www.w3.org/2003/11/swrl#>

time <http://imce.jpl.nasa.gov/foundation/time/time#>

time-backbone <http://imce.jpl.nasa.gov/backbone/imce.jpl.nasa.gov/foundation/time/time#>

time-embedding <http://imce.jpl.nasa.gov/foundation/time/time-embedding#>

time-embedding-backbone <http://imce.jpl.nasa.gov/backbone/imce.jpl.nasa.gov/foundation/time/time-embedding#>

vandv <http://imce.jpl.nasa.gov/discipline/vandv/vandv#>

vandv-backbone <http://imce.jpl.nasa.gov/backbone/imce.jpl.nasa.gov/discipline/vandv/vandv#>

vandv-embedding <http://imce.jpl.nasa.gov/discipline/vandv/vandv-embedding#>

vandv-embedding-backbone <http://imce.jpl.nasa.gov/backbone/imce.jpl.nasa.gov/discipline/vandv/vandv-embedding#>

xsd <http://www.w3.org/2001/XMLSchema#>

xsd-backbone <http://imce.jpl.nasa.gov/backbone/www.w3.org/2001/XMLSchema#>

4 Abstract Class Definitions

4.1 AssignedElement

An *AssignedElement* is any model element that can have the *isAssignedTo* relationship with a *Role*.

Asserted Superclasses: project-backbone:Aspect

Inferred Superclasses: project-backbone:Thing

Asserted Subclasses: Delivers, DevelopedElement, Executes, Process, Receives, ReliesOn, Supplies

Asserted Object Properties: **isAssignedTo** [0..*] Role

The class definition diagram for *AssignedElement* is shown in Figure 1.

4.2 DevelopedElement

A *DevelopedElement* is any model element that manifests *DevelopmentStates*. Example *DevelopedElements* include spacecraft, thermal test facility, and requirements document.

Asserted Superclasses: AssignedElement, project-backbone:Aspect

Inferred Superclasses: project-backbone:Thing

Asserted Subclasses: Facility, mission:Component, mission:Interface, Product

Asserted Object Properties: **isDescribedBy** [0..*] Product

isReliedOnBy [0..*] Authority

manifests [0..*] DevelopmentState

Inferred Object Properties: **isAssignedTo** [0..*] Role

The class definition diagram for *DevelopedElement* is shown in Figure 2.

4.3 RealizedElement

A *RealizedElement* is any element that *realizes* or *isRealizedBy* another element.

Asserted Superclasses: project-backbone:Aspect

Inferred Superclasses: project-backbone:Thing

Asserted Subclasses: mission:Component, mission:Function, mission:Interface, mission:Junction, mission:Mission, Process, Project, WorkPackage

Asserted Object Properties: **isRealizedBy** [0..*] RealizedElement

realizes [0..*] RealizedElement

The class definition diagram for *RealizedElement* is shown in Figure 3.

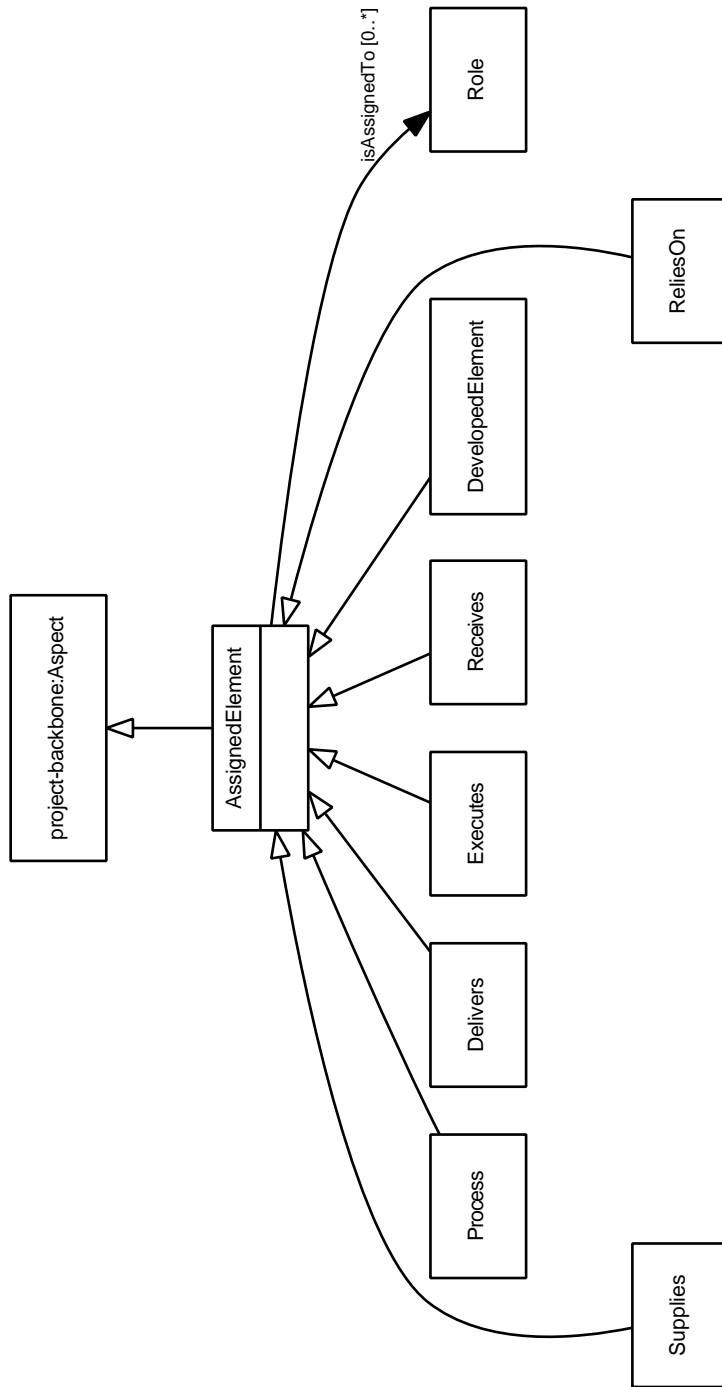
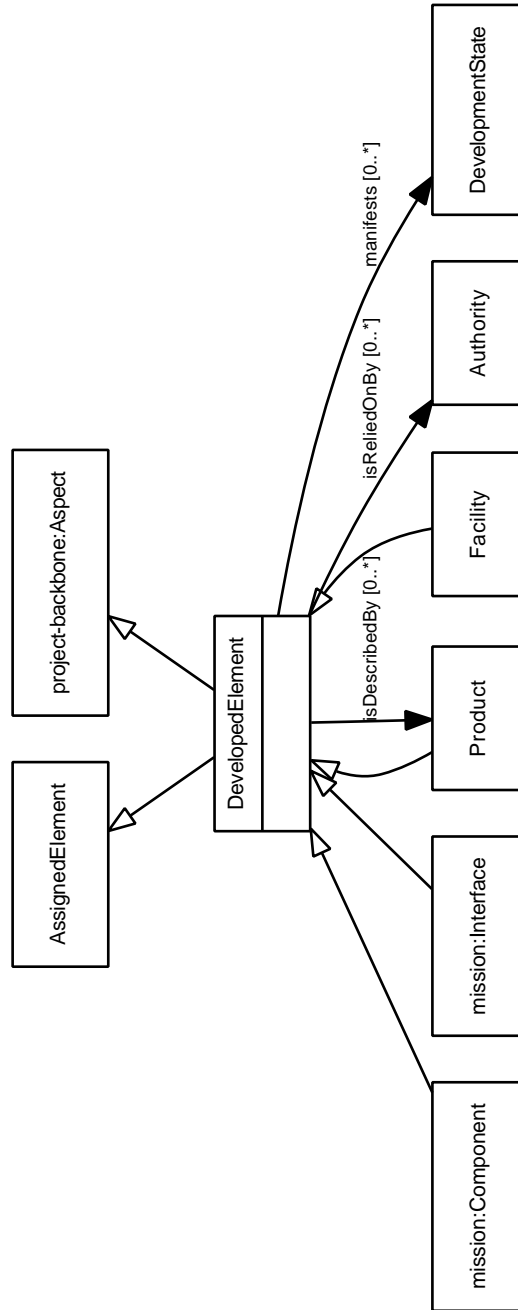


Figure 1: Class definition diagram for `AssignedElement`.

Figure 2: Class definition diagram for `DevelopedElement`.

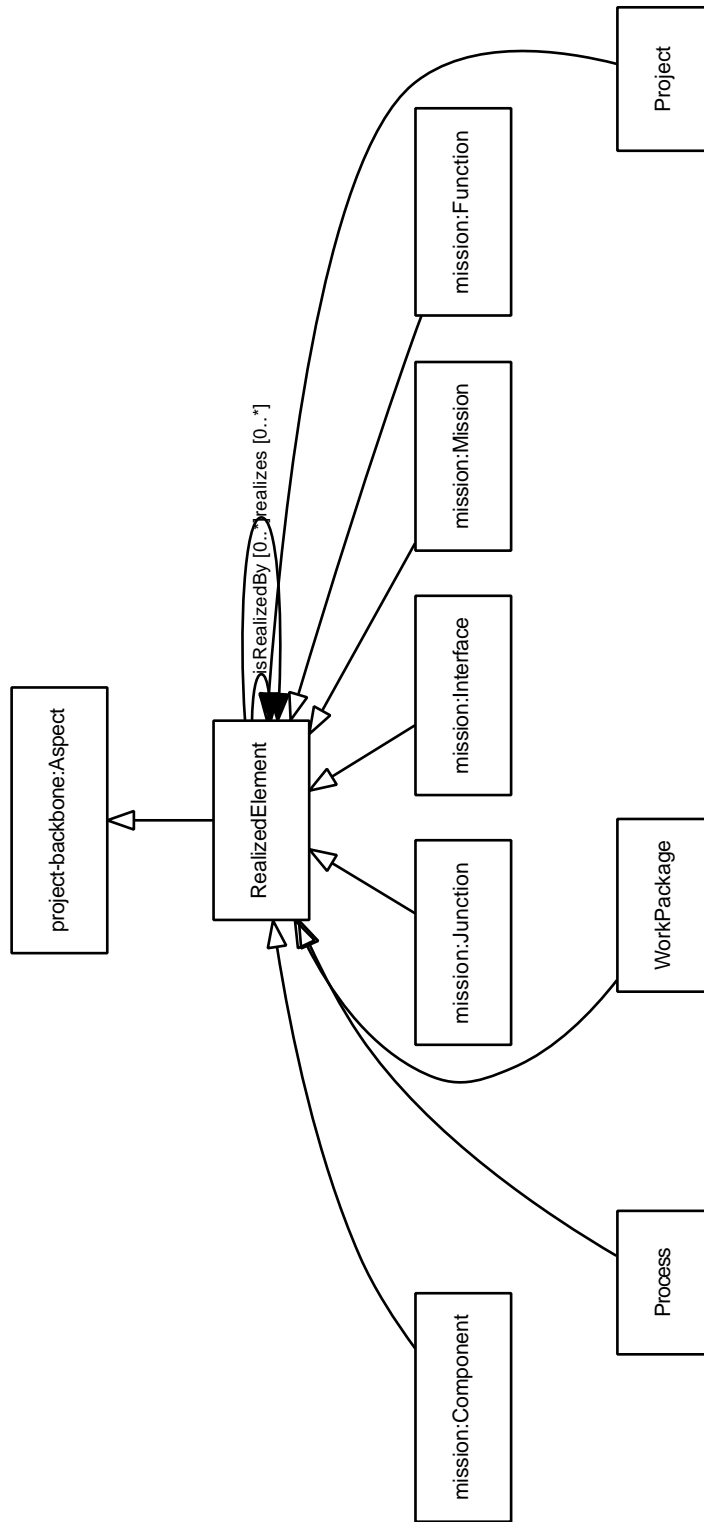


Figure 3: Class definition diagram for RealizedElement.

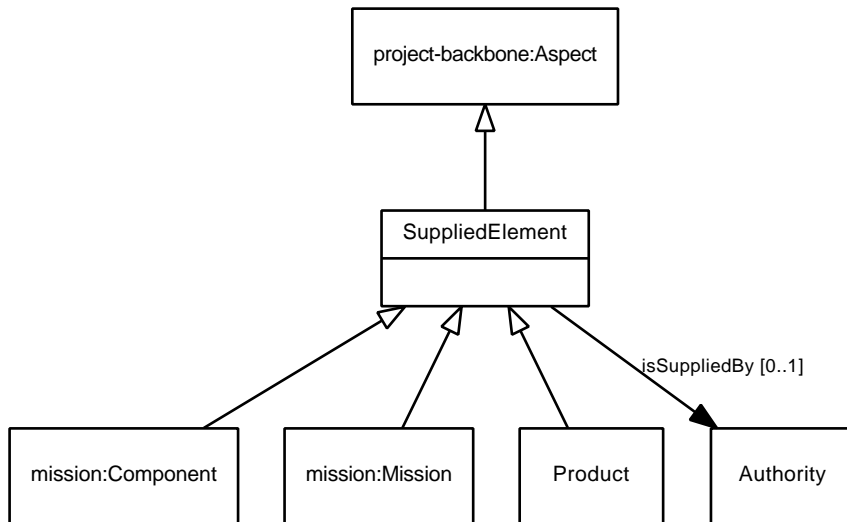


Figure 4: Class definition diagram for *SuppliedElement*.

4.4 *SuppliedElement*

A *SuppliedElement* is any model element that an *Authority* properly *supplies*. Example *SuppliedElements* include *Mission* and *Component*.

Asserted Superclasses: project-backbone:Aspect

Inferred Superclasses: project-backbone:Thing

Asserted Subclasses: mission:Component, mission:Mission, Product

Asserted Object Properties: isSuppliedBy [0..1] Authority

The class definition diagram for *SuppliedElement* is shown in Figure 4.

5 Concrete Class Definitions

5.1 Authority

An *Authority* is any entity that asserts a fact in a model. Example *Authorities* include *Program*, *Project*, and *WorkPackage*. (The association of an *Authority* with its asserted facts requires mechanisms outside the vocabulary of OWL itself, e.g., named graphs. For this reason, there is no object property *authorizes*. Authorization is conveyed by the organization of statements in a repository.)

Asserted Superclasses: base:Package, project-backbone:Entity

Inferred Superclasses: analysis-backbone:Aspect, analysis-backbone:Thing, analysis:AnalyzedElement, analysis:CharacterizedElement, base-backbone:Aspect, base-backbone:Entity, base-backbone:Thing, base:IdentifiedElement, project-backbone:Thing

Asserted Subclasses: Program, Project, WorkPackage

Inferred Datatype Properties: base:hasAlternateName [0..*] xsd:string

base:hasCanonicalName [0..1] xsd:string

base:hasDescription [0..1] xsd:string

base:hasIdentifier [0..*] xsd:string

base:hasIndexEntry [0..*] xsd:string

base:hasShortName [0..1] xsd:string

base:hasSortKey [0..1] xsd:string

base:hasUuid [0..1] xsd:string

Asserted Object Properties: authorizes [0..*] Authority

executes [0..*] Process

isResponsibilityOf [0..1] Organization

produces [0..*] Product

reliesOn [0..*] DevelopedElement

supplies [0..*] SuppliedElement

Inferred Object Properties: analysis:isAnalyzedBy [0..*] analysis:Explanation

analysis:isCharacterizedBy [0..*] analysis:Characterization

analysis:isExplainedBy [0..*] analysis:Explanation

analysis:isLimitedBy [0..*] analysis:Assumption

analysis:isValidatedBy [0..*] analysis:Explanation

The class definition diagram for Authority is shown in Figure 5. The class usage diagram for Authority is shown in Figure 6.

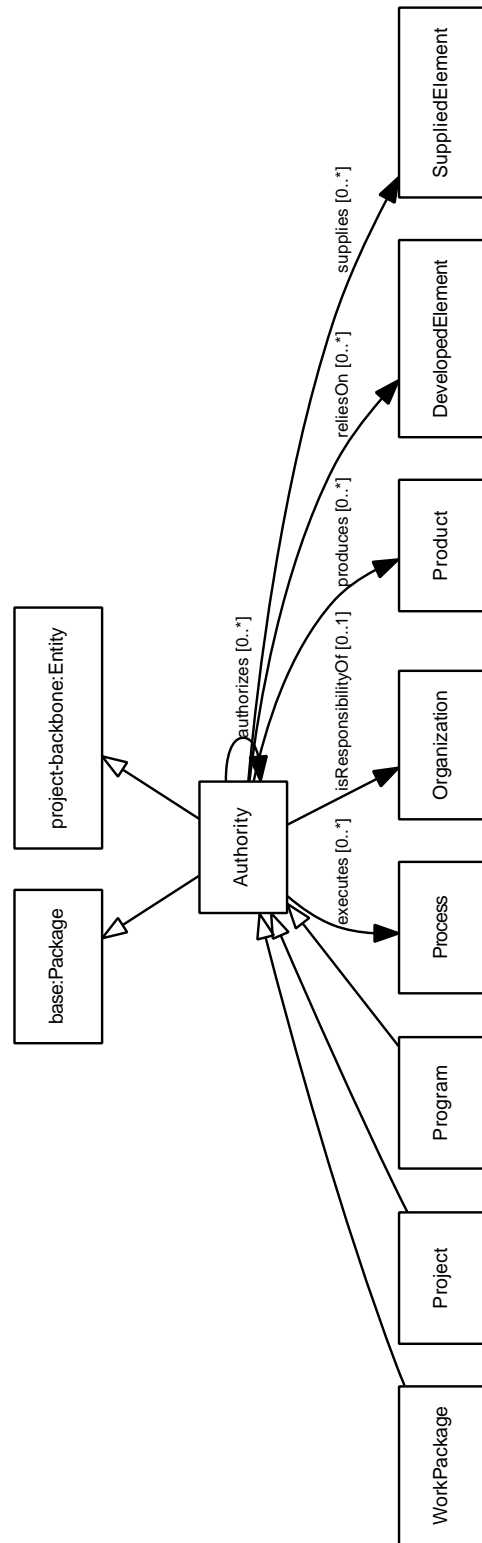


Figure 5: Class definition diagram for Authority.

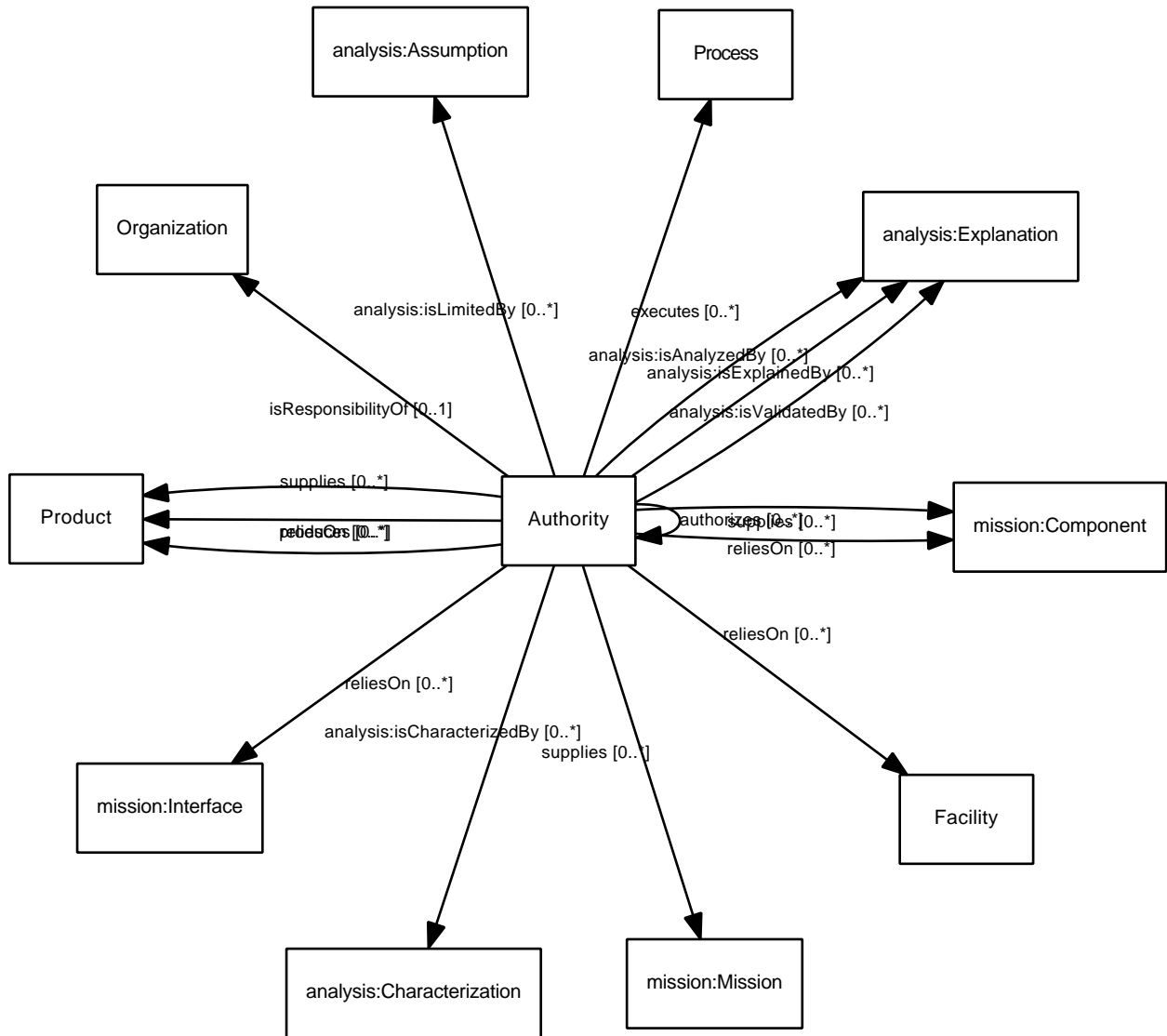


Figure 6: Class usage diagram for Authority.

5.2 Concern

A *Concern* represents a specific interest that one or more stakeholders have in the successful completion of a *Project* or *Program* and its *Missions*.

Asserted Superclasses: analysis:MeasuredElement, base:AggregatedElement, base:IdentifiedElement, project-backbone:Entity

Inferred Superclasses: analysis-backbone:Aspect, analysis-backbone:Thing, analysis:AnalyzedElement, analysis:CharacterizedElement, base-backbone:Aspect, base-backbone:Thing, project-backbone:Thing

Asserted Subclasses: mission:Objective

Inferred Datatype Properties: **base:hasAlternateName** [0..*] xsd:string

base:hasCanonicalName [0..1] xsd:string

base:hasDescription [0..1] xsd:string

base:hasIdentifier [0..*] xsd:string

base:hasIndexEntry [0..*] xsd:string

base:hasShortName [0..1] xsd:string

base:hasSortKey [0..1] xsd:string

base:hasUuid [0..1] xsd:string

Asserted Object Properties: **isRepresentedBy** [0..*] Stakeholder

Inferred Object Properties: **analysis:isAnalyzedBy** [0..*] analysis:Explanation

analysis:isCharacterizedBy [0..*] analysis:Characterization

analysis:isExplainedBy [0..*] analysis:Explanation

analysis:isLimitedBy [0..*] analysis:Assumption

analysis:isMeasuredBy [0..*] analysis:Criterion

analysis:isValidatedBy [0..*] analysis:Explanation

base:aggregates [0..*] Concern

base:isAggregatedIn [0..*] Concern

The class definition diagram for Concern is shown in Figure 7. The class usage diagram for Concern is shown in Figure 8.

5.3 Deliverable

A *Deliverable* is the result of successful execution of a *Process*. It may be an input to or prerequisite for another *Process*.

Asserted Superclasses: base:IdentifiedElement, project-backbone:Entity

Inferred Superclasses: analysis-backbone:Aspect, analysis-backbone:Thing, analysis:AnalyzedElement, analysis:CharacterizedElement, base-backbone:Aspect, base-backbone:Thing, project-backbone:Thing

Asserted Subclasses: DevelopmentState

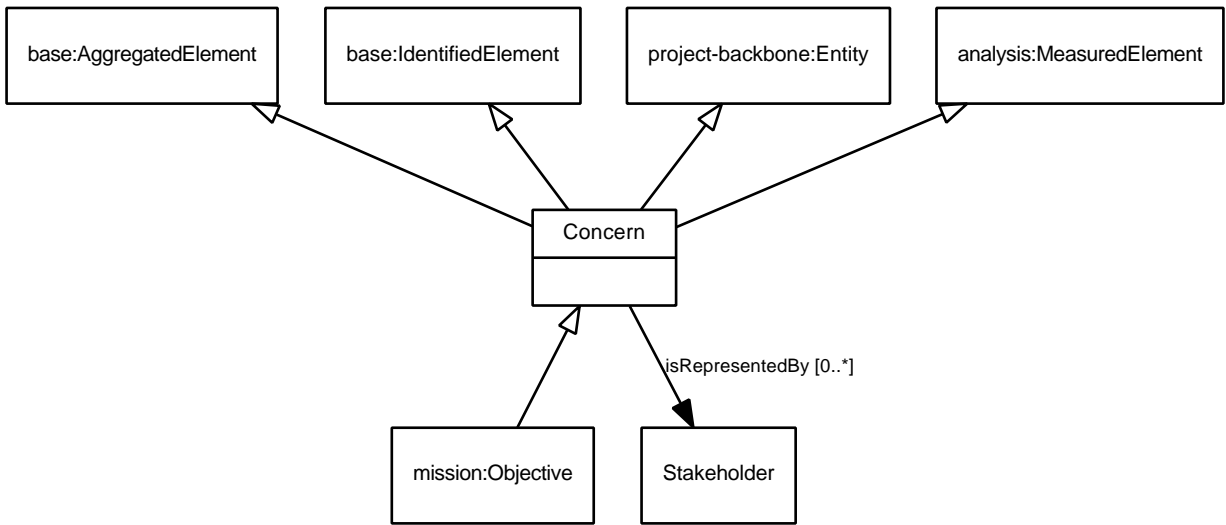


Figure 7: Class definition diagram for Concern.

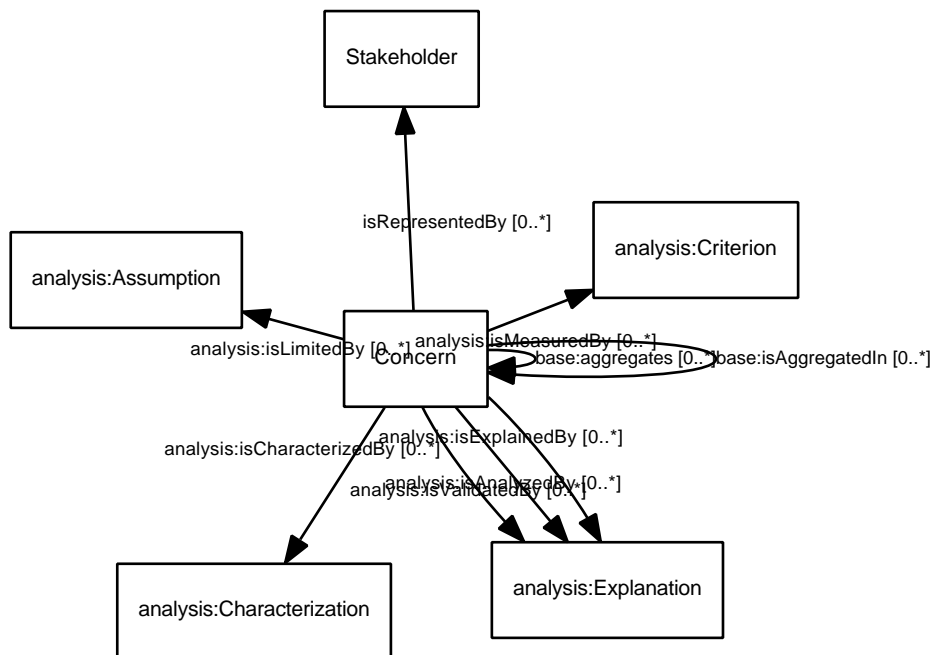


Figure 8: Class usage diagram for Concern.

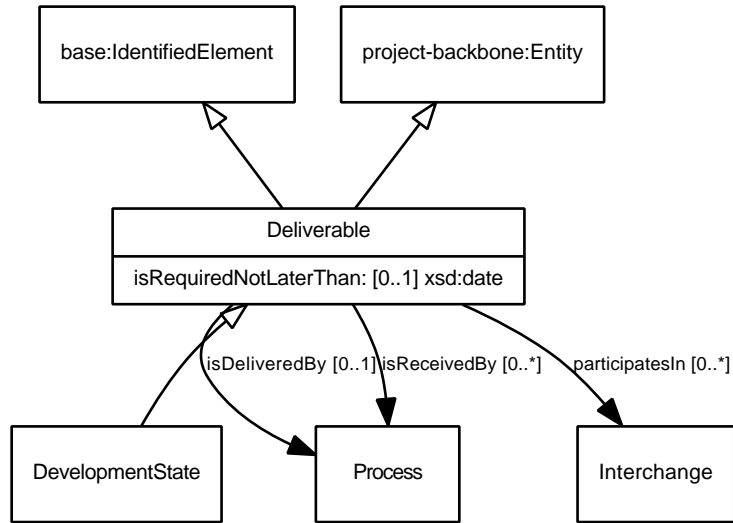


Figure 9: Class definition diagram for Deliverable.

Asserted Datatype Properties: **isRequiredNotLaterThan** [0..1] xsd:date

Inferred Datatype Properties: **base:hasAlternateName** [0..*] xsd:string

base:hasCanonicalName [0..1] xsd:string

base:hasDescription [0..1] xsd:string

base:hasIdentifier [0..*] xsd:string

base:hasIndexEntry [0..*] xsd:string

base:hasShortName [0..1] xsd:string

base:hasSortKey [0..1] xsd:string

base:hasUuid [0..1] xsd:string

Asserted Object Properties: **isDeliveredBy** [0..1] Process

isReceivedBy [0..*] Process

participatesIn [0..*] Interchange

Inferred Object Properties: **analysis:isAnalyzedBy** [0..*] analysis:Explanation

analysis:isCharacterizedBy [0..*] analysis:Characterization

analysis:isExplainedBy [0..*] analysis:Explanation

analysis:isLimitedBy [0..*] analysis:Assumption

analysis:isValidatedBy [0..*] analysis:Explanation

The class definition diagram for Deliverable is shown in Figure 9. The class usage diagram for Deliverable is shown in Figure 10.

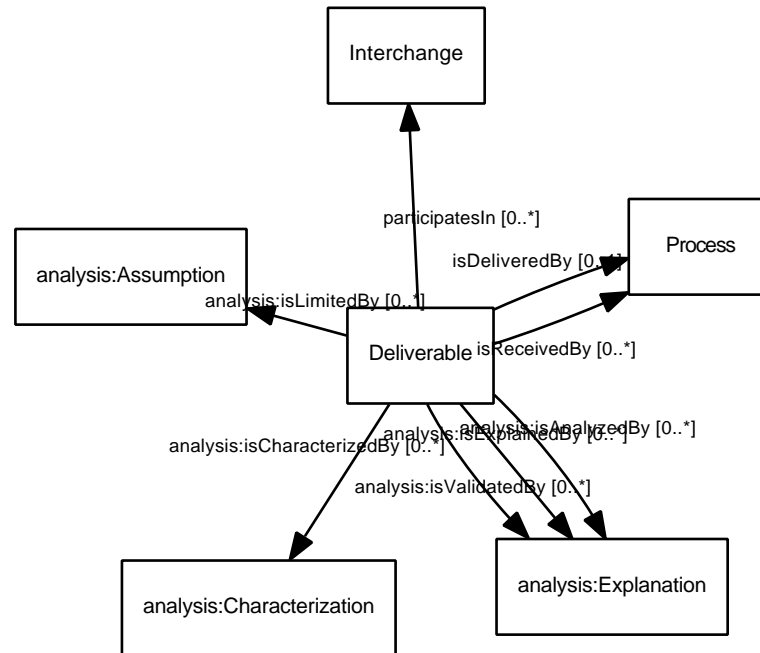


Figure 10: Class usage diagram for Deliverable.

5.4 DevelopmentState

A *DevelopmentState* is a kind of *Deliverable* that represents a defined condition for a *DevelopedElement*. *DevelopmentStates* may be unique to the *DevelopedElement*; example *DevelopmentStates* for a *Product* include Preliminary, Draft, and Final.

Asserted Superclasses: Deliverable

Inferred Superclasses: analysis-backbone:Aspect, analysis-backbone:Thing, analysis:AnalyzedElement, analysis:CharacterizedElement, base-backbone:Aspect, base-backbone:Thing, base:IdentifiedElement, project-backbone:Entity, project-backbone:Thing

Inferred Datatype Properties: base:hasAlternateName [0..*] xsd:string

base:hasCanonicalName [0..1] xsd:string

base:hasDescription [0..1] xsd:string

base:hasIdentifier [0..*] xsd:string

base:hasIndexEntry [0..*] xsd:string

base:hasShortName [0..1] xsd:string

base:hasSortKey [0..1] xsd:string

base:hasUuid [0..1] xsd:string

isRequiredNotLaterThan [0..1] xsd:date

Asserted Object Properties: isManifestedBy [0..1] DevelopedElement

Inferred Object Properties: analysis:isAnalyzedBy [0..*] analysis:Explanation

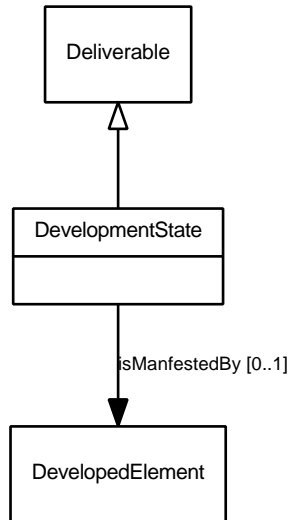


Figure 11: Class definition diagram for DevelopmentState.

analysis:isCharacterizedBy [0..*] analysis:Characterization

analysis:isExplainedBy [0..*] analysis:Explanation

analysis:isLimitedBy [0..*] analysis:Assumption

analysis:isValidatedBy [0..*] analysis:Explanation

isDeliveredBy [0..1] Process

isReceivedBy [0..*] Process

participatesIn [0..*] Interchange

The class definition diagram for DevelopmentState is shown in Figure 11. The class usage diagram for DevelopmentState is shown in Figure 12.

5.5 Facility

A *Facility* is any asset (e.g., laboratory, assembly facility, test facility, etc.) whose *DevelopmentState* may be a *Deliverable* for a project process.

Asserted Superclasses: base:IdentifiedElement, DevelopedElement, project-backbone:Entity

Inferred Superclasses: analysis-backbone:Aspect, analysis-backbone:Thing, analysis:AnalyzedElement, analysis:CharacterizedElement, AssignedElement, base-backbone:Aspect, base-backbone:Thing, project-backbone:Aspect, project-backbone:Thing

Inferred Datatype Properties: base:hasAlternateName [0..*] xsd:string

base:hasCanonicalName [0..1] xsd:string

base:hasDescription [0..1] xsd:string

base:hasIdentifier [0..*] xsd:string

base:hasIndexEntry [0..*] xsd:string

base:hasShortName [0..1] xsd:string

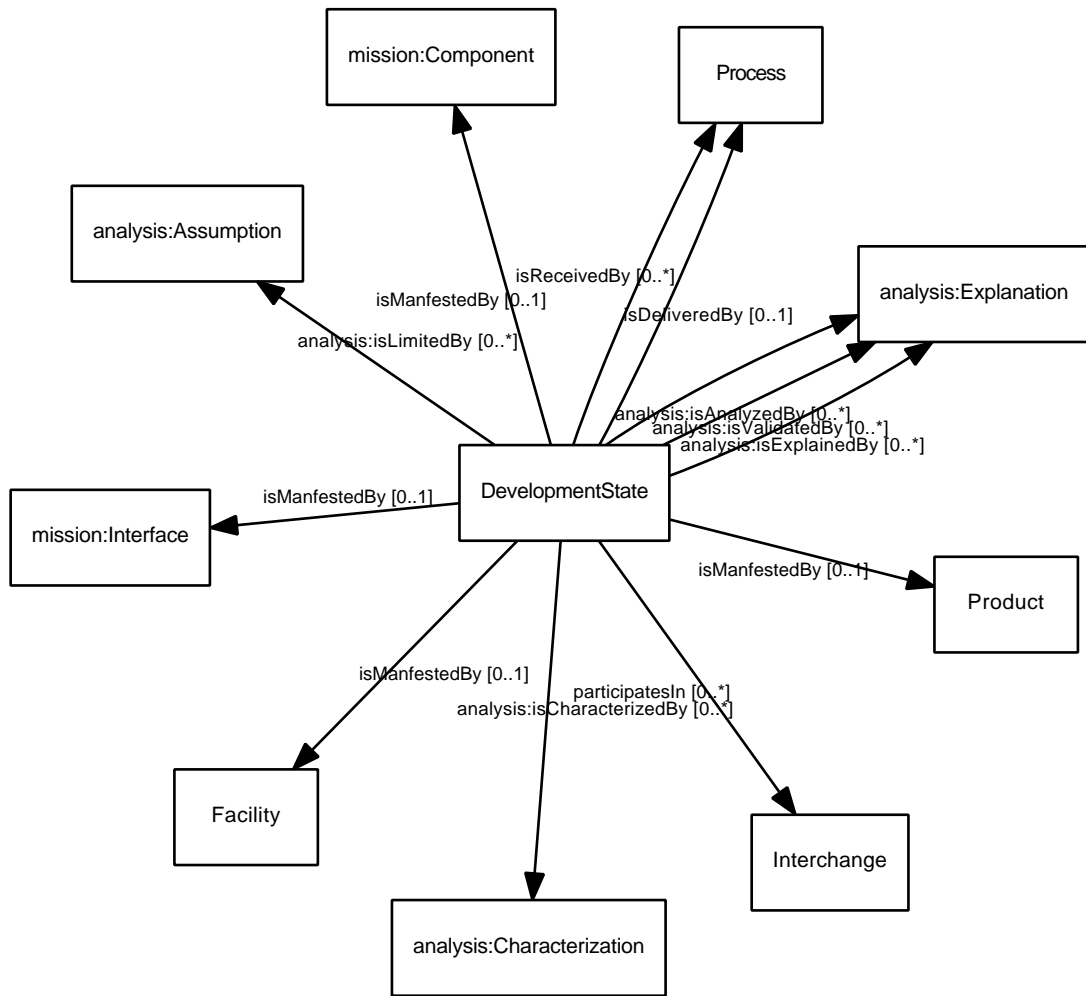


Figure 12: Class usage diagram for `DevelopmentState`.

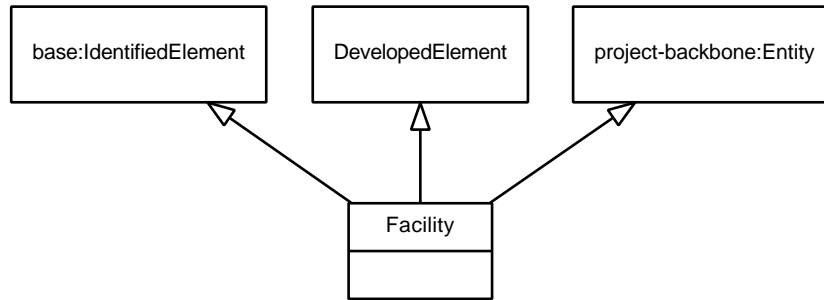


Figure 13: Class definition diagram for Facility.

base:hasSortKey [0..1] xsd:string

base:hasUuid [0..1] xsd:string

Inferred Object Properties: **analysis:isAnalyzedBy** [0..*] analysis:Explanation

analysis:isCharacterizedBy [0..*] analysis:Characterization

analysis:isExplainedBy [0..*] analysis:Explanation

analysis:isLimitedBy [0..*] analysis:Assumption

analysis:isValidatedBy [0..*] analysis:Explanation

isAssignedTo [0..*] Role

isDescribedBy [0..*] Product

isReliedOnBy [0..*] Authority

manifests [0..*] DevelopmentState

The class definition diagram for Facility is shown in Figure 13. The class usage diagram for Facility is shown in Figure 14.

5.6 Interchange

An *Interchange* represents the intended joint behavior of a pair of *Processes*. It indicates that a *Deliverable* may be delivered by one *Process* and received by the other *Process*.

Asserted Superclasses: base:IdentifiedElement, project-backbone:Entity

Inferred Superclasses: analysis-backbone:Aspect, analysis-backbone:Thing, analysis:AnalyzedElement, analysis:CharacterizedElement, base-backbone:Aspect, base-backbone:Thing, project-backbone:Thing

Inferred Datatype Properties: **base:hasAlternateName** [0..*] xsd:string

base:hasCanonicalName [0..1] xsd:string

base:hasDescription [0..1] xsd:string

base:hasIdentifier [0..*] xsd:string

base:hasIndexEntry [0..*] xsd:string

base:hasShortName [0..1] xsd:string

base:hasSortKey [0..1] xsd:string

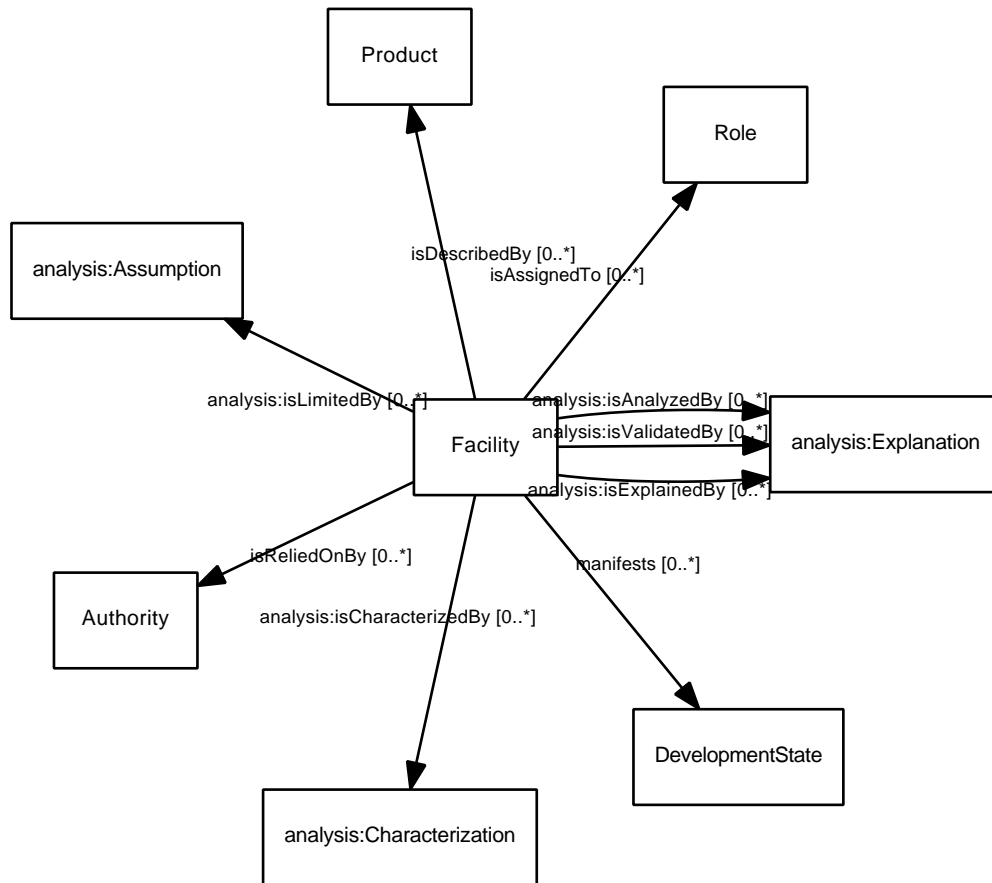


Figure 14: Class usage diagram for Facility.

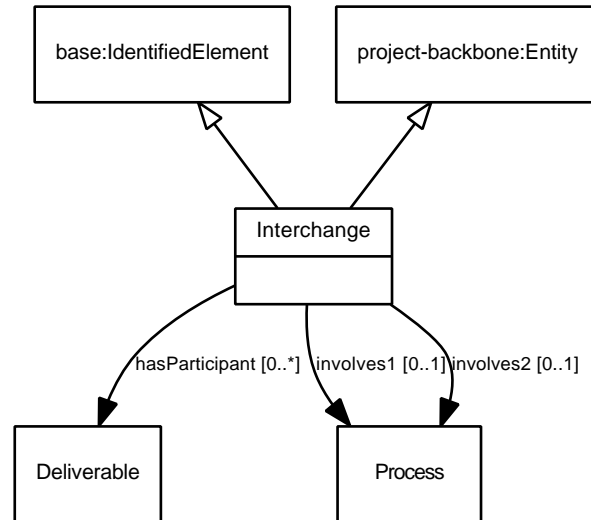


Figure 15: Class definition diagram for Interchange.

base:hasUuid [0..1] xsd:string

Asserted Object Properties: **hasParticipant** [0..*] Deliverable

involves1 [0..1] Process

involves2 [0..1] Process

Inferred Object Properties: **analysis:isAnalyzedBy** [0..*] analysis:Explanation

analysis:isCharacterizedBy [0..*] analysis:Characterization

analysis:isExplainedBy [0..*] analysis:Explanation

analysis:isLimitedBy [0..*] analysis:Assumption

analysis:isValidatedBy [0..*] analysis:Explanation

The class definition diagram for Interchange is shown in Figure 15. The class usage diagram for Interchange is shown in Figure 16.

5.7 Organization

An *Organization* is any entity that *isResponsibleFor* a *Authority*.

Asserted Superclasses: project-backbone:Entity

Inferred Superclasses: analysis-backbone:Aspect, analysis-backbone:Thing, analysis:AnalyzedElement, analysis:CharacterizedElement, project-backbone:Thing

Asserted Object Properties: **hasResponsibilityFor** [0..*] Authority

Inferred Object Properties: **analysis:isAnalyzedBy** [0..*] analysis:Explanation

analysis:isCharacterizedBy [0..*] analysis:Characterization

analysis:isExplainedBy [0..*] analysis:Explanation

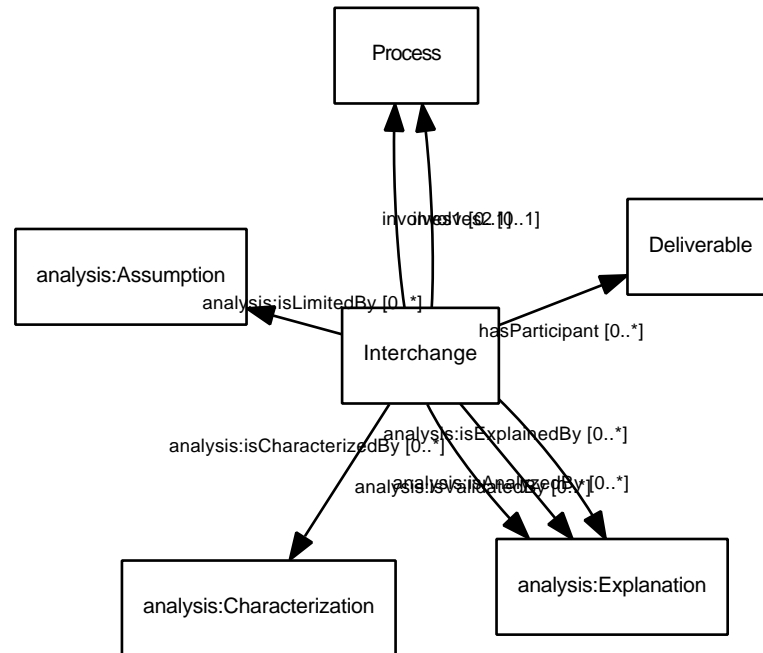


Figure 16: Class usage diagram for Interchange.

analysis:isLimitedBy [0..*] analysis:Assumption

analysis:isValidatedBy [0..*] analysis:Explanation

The class definition diagram for Organization is shown in Figure 17. The class usage diagram for Organization is shown in Figure 18.

5.8 Person

A *Person* corresponds to an individual named person. A *Person* belongsTo zero or more *Organizations*.

Asserted Superclasses: base:IdentifiedElement, project-backbone:Entity

Inferred Superclasses: analysis-backbone:Aspect, analysis-backbone:Thing, analysis:AnalyzedElement, analysis:CharacterizedElement, base-backbone:Aspect, base-backbone:Thing, project-backbone:Thing

Inferred Datatype Properties: **base:hasAlternateName** [0..*] xsd:string

base:hasCanonicalName [0..1] xsd:string

base:hasDescription [0..1] xsd:string

base:hasIdentifier [0..*] xsd:string

base:hasIndexEntry [0..*] xsd:string

base:hasShortName [0..1] xsd:string

base:hasSortKey [0..1] xsd:string

base:hasUuid [0..1] xsd:string

Asserted Object Properties: **belongsTo** [0..*] Organization

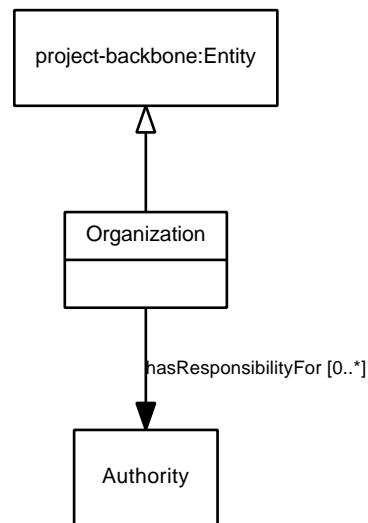


Figure 17: Class definition diagram for Organization.

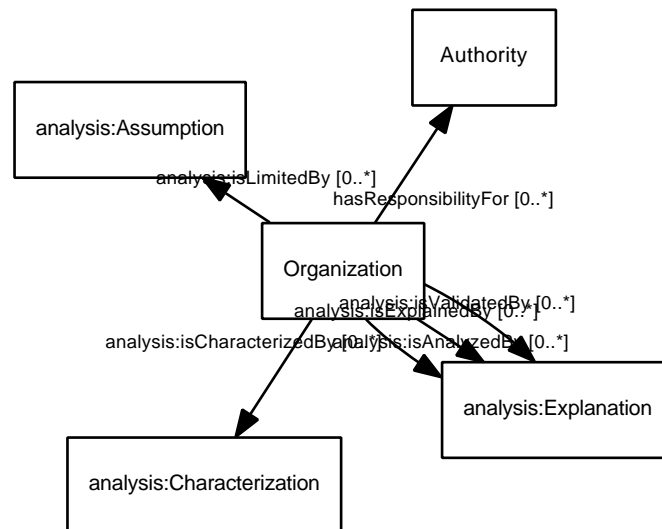


Figure 18: Class usage diagram for Organization.

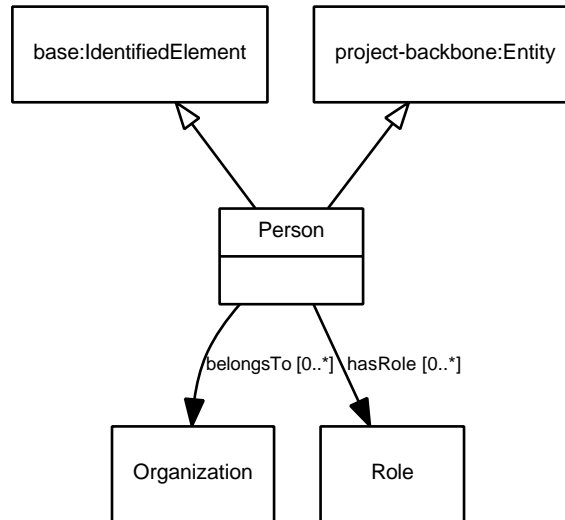


Figure 19: Class definition diagram for Person.

hasRole [0..*] Role

Inferred Object Properties: **analysis:isAnalyzedBy** [0..*] analysis:Explanation

analysis:isCharacterizedBy [0..*] analysis:Characterization

analysis:isExplainedBy [0..*] analysis:Explanation

analysis:isLimitedBy [0..*] analysis:Assumption

analysis:isValidatedBy [0..*] analysis:Explanation

The class definition diagram for Person is shown in Figure 19. The class usage diagram for Person is shown in Figure 20.

5.9 Policy

A *Policy* represents a specific exercise of authority that *binds* one or more model elements.

Asserted Superclasses: project-backbone:Entity

Inferred Superclasses: analysis-backbone:Aspect, analysis-backbone:Thing, analysis:AnalyzedElement, analysis:CharacterizedElement, project-backbone:Thing

Asserted Object Properties: **binds** [0..*] mission:SpecifiedElement

Inferred Object Properties: **analysis:isAnalyzedBy** [0..*] analysis:Explanation

analysis:isCharacterizedBy [0..*] analysis:Characterization

analysis:isExplainedBy [0..*] analysis:Explanation

analysis:isLimitedBy [0..*] analysis:Assumption

analysis:isValidatedBy [0..*] analysis:Explanation

The class definition diagram for Policy is shown in Figure 21. The class usage diagram for Policy is shown in Figure 22.

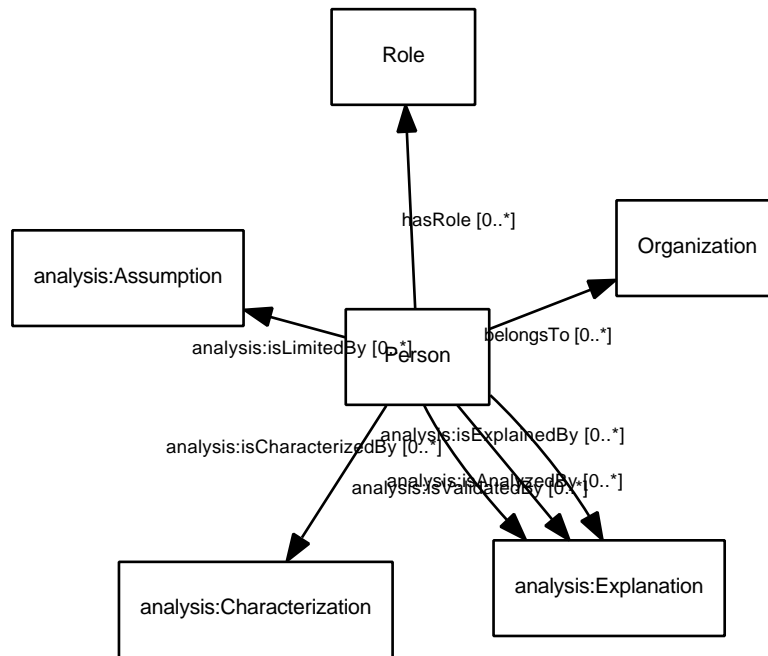


Figure 20: Class use diagram for Person.

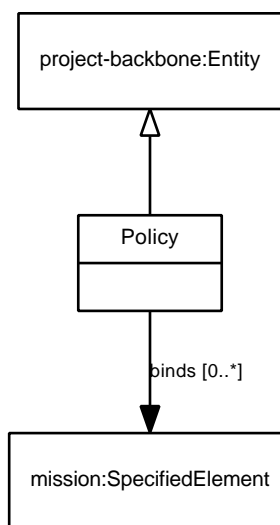


Figure 21: Class definition diagram for Policy.

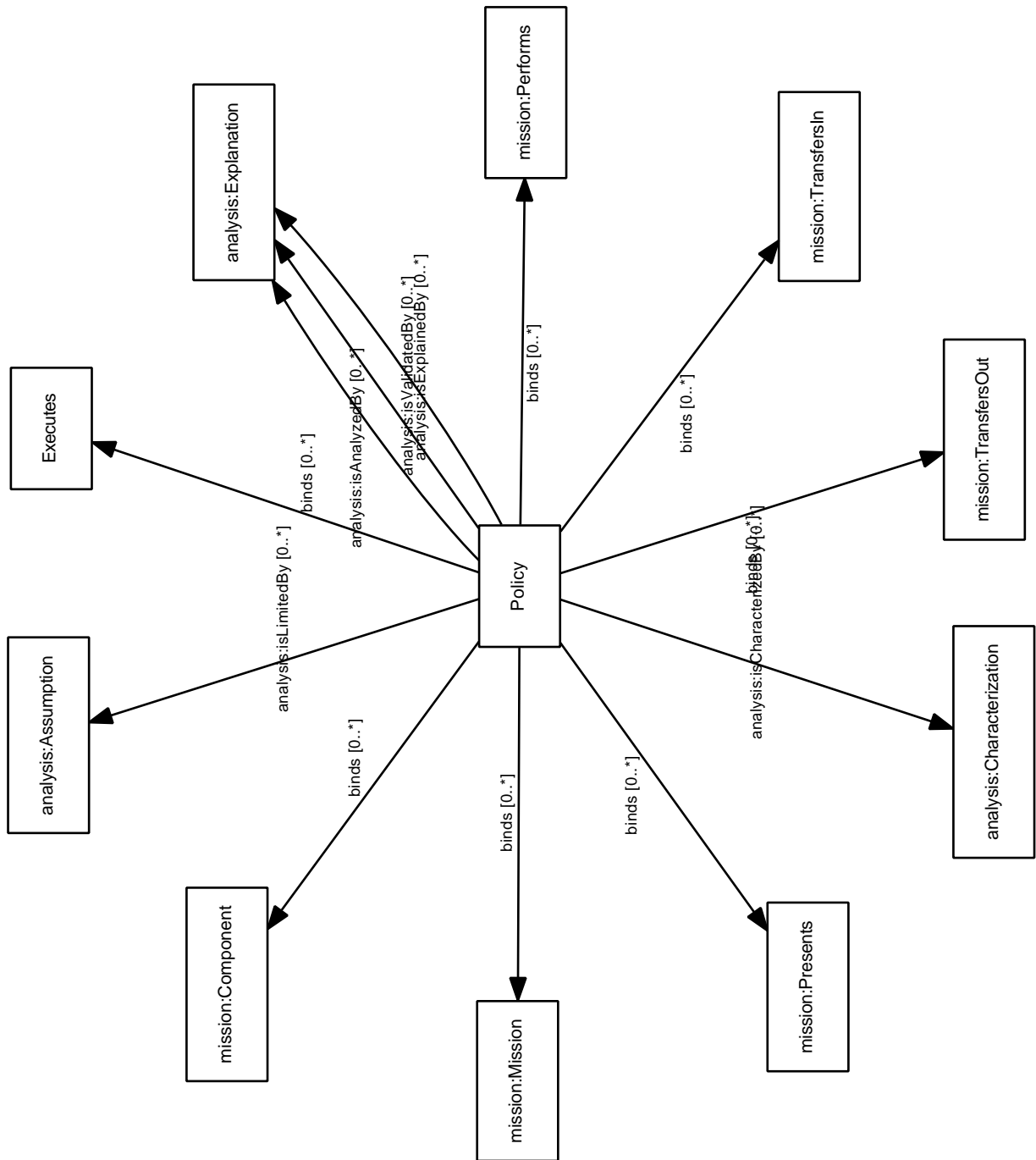


Figure 22: Class usage diagram for Policy.

5.10 Process

A *Process* is an activity authorized by a *WorkPackage* in support of delivering a *Component* or producing a *Product*. Examples include *design trajectory*, *conduct trade study*, and *review subsystem design*.

Asserted Superclasses: *AssignedElement*, *base:IdentifiedElement*, *project-backbone:Entity*, *RealizedElement*

Inferred Superclasses: *analysis-backbone:Aspect*, *analysis-backbone:Thing*, *analysis:AnalyzedElement*, *analysis:CharacterizedElement*, *base-backbone:Aspect*, *base-backbone:Thing*, *project-backbone:Aspect*, *project-backbone:Thing*

Inferred Datatype Properties: **base:hasAlternateName** [0..*] xsd:string

base:hasCanonicalName [0..1] xsd:string

base:hasDescription [0..1] xsd:string

base:hasIdentifier [0..*] xsd:string

base:hasIndexEntry [0..*] xsd:string

base:hasShortName [0..1] xsd:string

base:hasSortKey [0..1] xsd:string

base:hasUuid [0..1] xsd:string

Asserted Object Properties: **delivers** [0..*] *Deliverable*

invokes [0..*] *Process*

isExecutedBy [0..1] *Authority*

isInvokedBy [0..*] *Process*

isInvolvedIn1 [0..*] *Interchange*

isInvolvedIn2 [0..*] *Interchange*

receives [0..*] *Deliverable*

Inferred Object Properties: **analysis:isAnalyzedBy** [0..*] *analysis:Explanation*

analysis:isCharacterizedBy [0..*] *analysis:Characterization*

analysis:isExplainedBy [0..*] *analysis:Explanation*

analysis:isLimitedBy [0..*] *analysis:Assumption*

analysis:isValidatedBy [0..*] *analysis:Explanation*

isAssignedTo [0..*] *Role*

isRealizedBy [0..*] *Process*

realizes [0..*] *Process*

The class definition diagram for *Process* is shown in Figure 23. The class usage diagram for *Process* is shown in Figure 24.

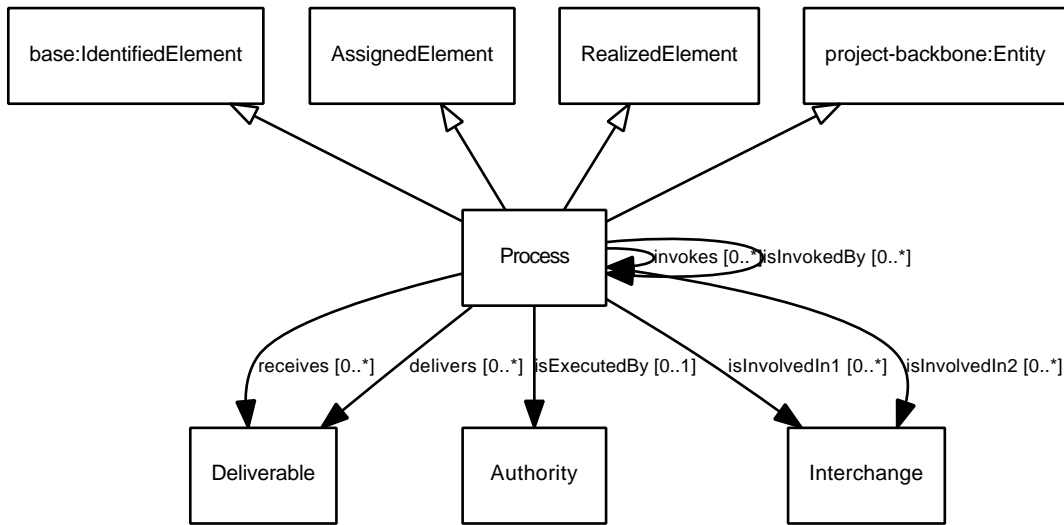


Figure 23: Class definition diagram for Process.

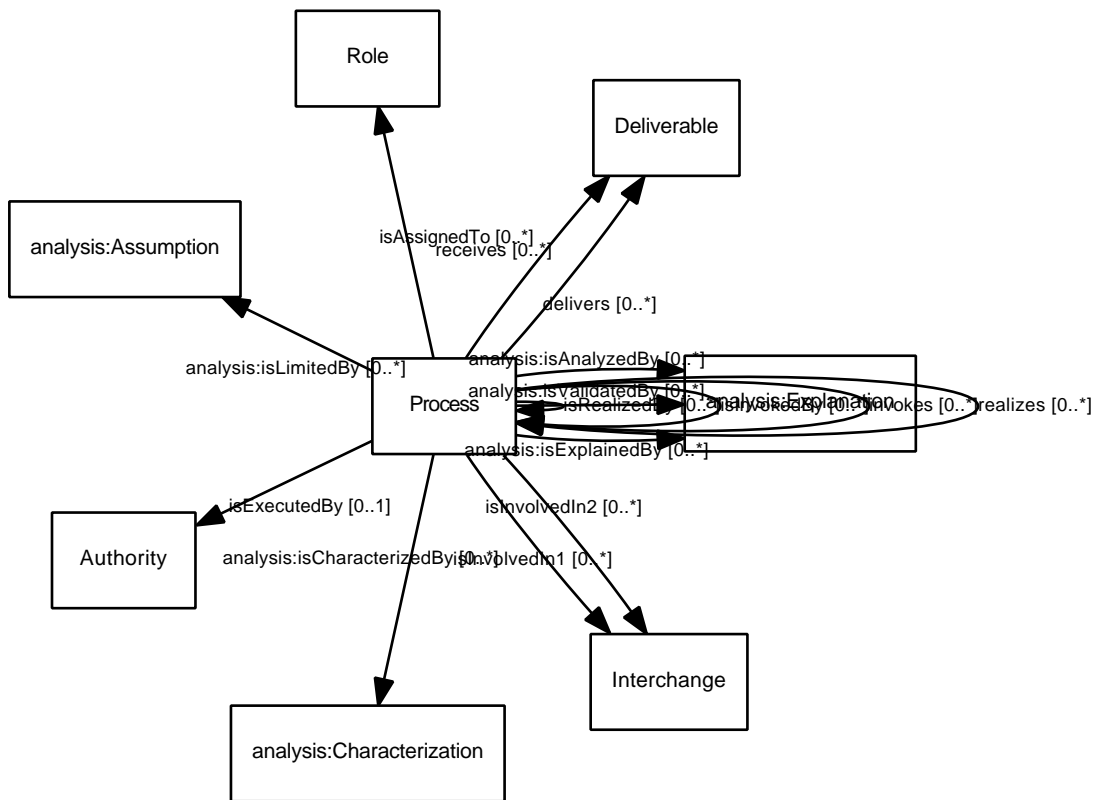


Figure 24: Class usage diagram for Process.

5.11 Product

A *Product* is a document or other artifact supplied by a *WorkPackage*. Example *Products* include trade study reports, design documents, and inspection reports.

Asserted Superclasses: base:AggregatedElement, base:IdentifiedElement, DevelopedElement, project-backbone:Entity, SuppliedElement

Inferred Superclasses: analysis-backbone:Aspect, analysis-backbone:Thing, analysis:AnalyzedElement, analysis:CharacterizedElement, AssignedElement, base-backbone:Aspect, base-backbone:Thing, project-backbone:Aspect, project-backbone:Thing

Inferred Datatype Properties: base:hasAlternateName [0..*] xsd:string

base:hasCanonicalName [0..1] xsd:string

base:hasDescription [0..1] xsd:string

base:hasIdentifier [0..*] xsd:string

base:hasIndexEntry [0..*] xsd:string

base:hasShortName [0..1] xsd:string

base:hasSortKey [0..1] xsd:string

base:hasUuid [0..1] xsd:string

Asserted Object Properties: describes [0..*] DevelopedElement

isApprovedBy [0..*] Role

isConcurredBy [0..*] Role

isPreparedBy [0..*] Role

isProducedBy [0..1] Authority

Inferred Object Properties: analysis:isAnalyzedBy [0..*] analysis:Explanation

analysis:isCharacterizedBy [0..*] analysis:Characterization

analysis:isExplainedBy [0..*] analysis:Explanation

analysis:isLimitedBy [0..*] analysis:Assumption

analysis:isValidatedBy [0..*] analysis:Explanation

base:aggregates [0..*] Product

base:isAggregatedIn [0..*] Product

isAssignedTo [0..*] Role

isDescribedBy [0..*] Product

isReliedOnBy [0..*] Authority

isSuppliedBy [0..1] Authority

manifests [0..*] DevelopmentState

The class definition diagram for *Product* is shown in Figure 25. The class usage diagram for *Product* is shown in Figure 26.

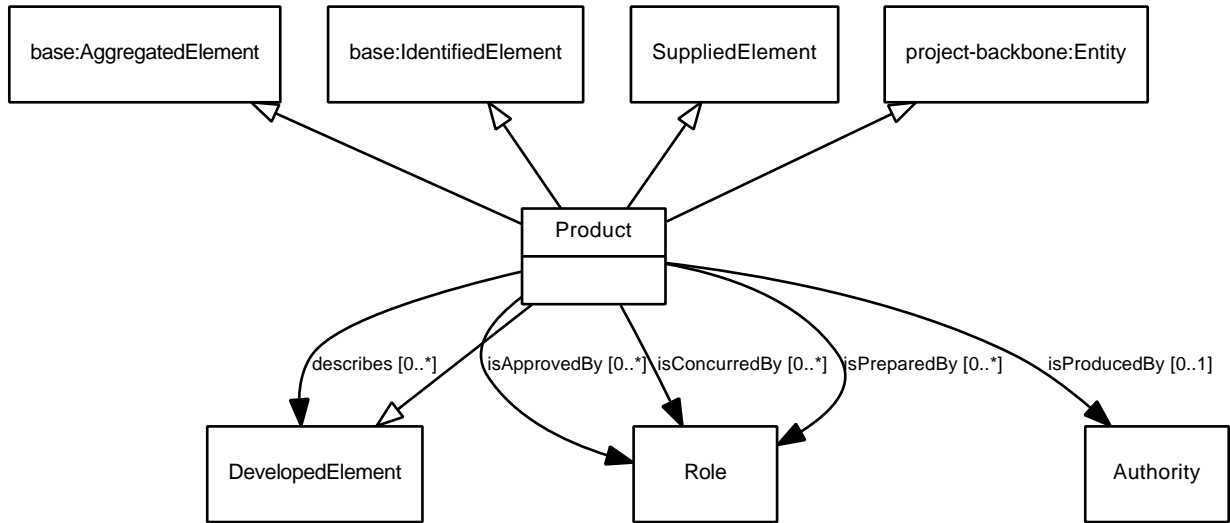


Figure 25: Class definition diagram for Product.

5.12 Program

Asserted Superclasses: Authority

Inferred Superclasses: analysis-backbone:Aspect, analysis-backbone:Thing, analysis:AnalyzedElement, analysis:CharacterizedElement, base-backbone:Aspect, base-backbone:Entity, base-backbone:Thing, base:IdentifiedElement, base:Package, project-backbone:Entity, project-backbone:Thing

Inferred Datatype Properties: **base:hasAlternateName** [0..*] xsd:string

base:hasCanonicalName [0..1] xsd:string

base:hasDescription [0..1] xsd:string

base:hasIdentifier [0..*] xsd:string

base:hasIndexEntry [0..*] xsd:string

base:hasShortName [0..1] xsd:string

base:hasSortKey [0..1] xsd:string

base:hasUuid [0..1] xsd:string

Inferred Object Properties: **analysis:isAnalyzedBy** [0..*] analysis:Explanation

analysis:isCharacterizedBy [0..*] analysis:Characterization

analysis:isExplainedBy [0..*] analysis:Explanation

analysis:isLimitedBy [0..*] analysis:Assumption

analysis:isValidatedBy [0..*] analysis:Explanation

authorizes [0..*] Authority

executes [0..*] Process

isResponsibilityOf [0..1] Organization

produces [0..*] Product

reliesOn [0..*] DevelopedElement

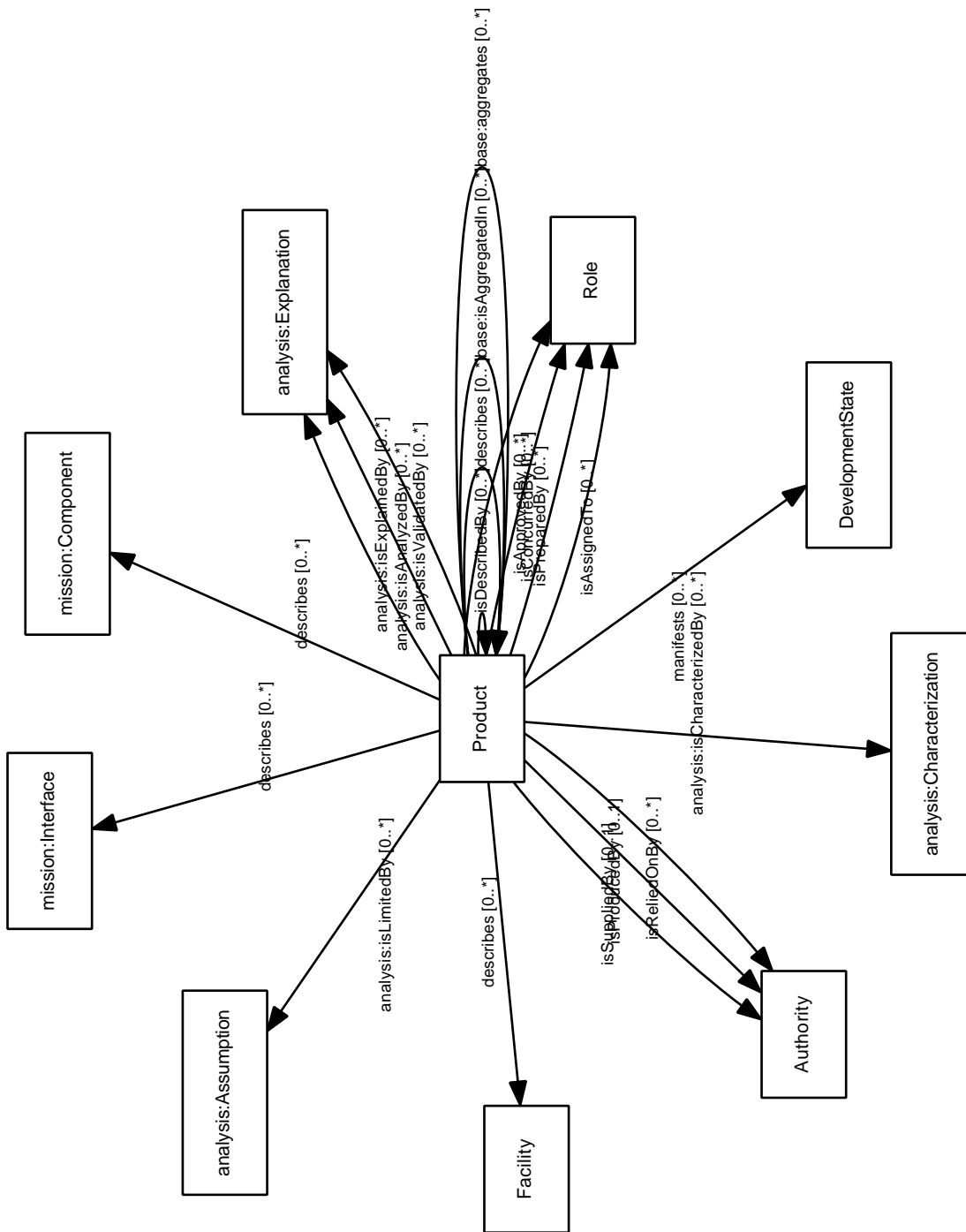


Figure 26: Class usage diagram for Product.

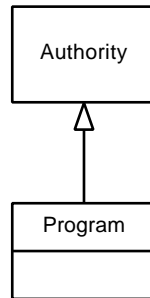


Figure 27: Class definition diagram for Program.

supplies [0..*] SuppliedElement

The class definition diagram for Program is shown in Figure 27. The class usage diagram for Program is shown in Figure 28.

5.13 Project

A *Project* is a kind of *Authority* that *supplies* a related set of *Missions* in pursuit of a set of *Objectives*.

Asserted Superclasses: Authority, RealizedElement

Inferred Superclasses: analysis-backbone:Aspect, analysis-backbone:Thing, analysis:AnalyzedElement, analysis:CharacterizedElement, base-backbone:Aspect, base-backbone:Entity, base-backbone:Thing, base:IdentifiedElement, base:Package, project-backbone:Aspect, project-backbone:Entity, project-backbone:Thing

Inferred Datatype Properties: **base:hasAlternateName** [0..*] xsd:string

base:hasCanonicalName [0..1] xsd:string

base:hasDescription [0..1] xsd:string

base:hasIdentifier [0..*] xsd:string

base:hasIndexEntry [0..*] xsd:string

base:hasShortName [0..1] xsd:string

base:hasSortKey [0..1] xsd:string

base:hasUuid [0..1] xsd:string

Inferred Object Properties: **analysis:isAnalyzedBy** [0..*] analysis:Explanation

analysis:isCharacterizedBy [0..*] analysis:Characterization

analysis:isExplainedBy [0..*] analysis:Explanation

analysis:isLimitedBy [0..*] analysis:Assumption

analysis:isValidatedBy [0..*] analysis:Explanation

authorizes [0..*] Authority

executes [0..*] Process

isRealizedBy [0..*] Project

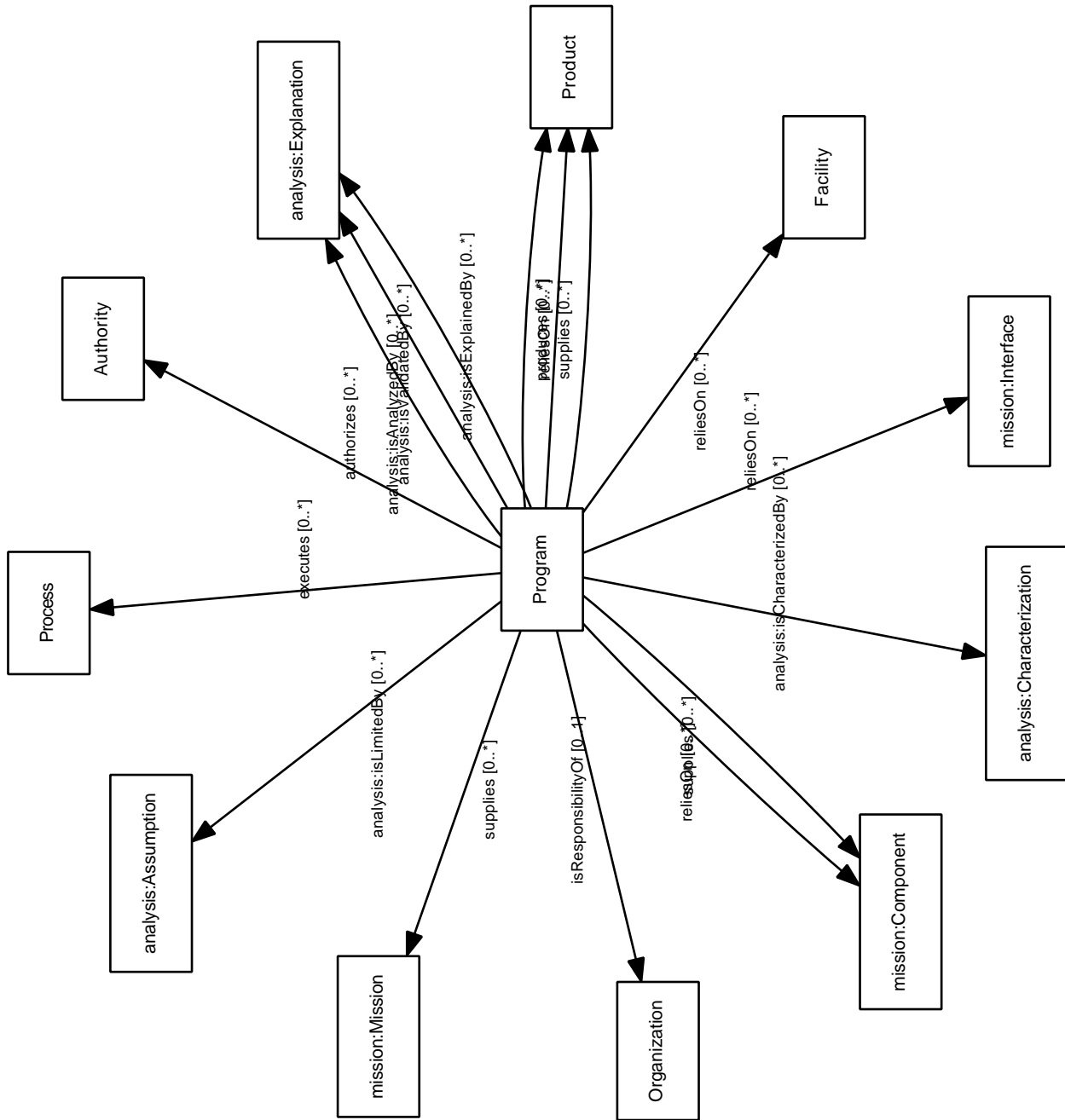


Figure 28: Class usage diagram for Program.

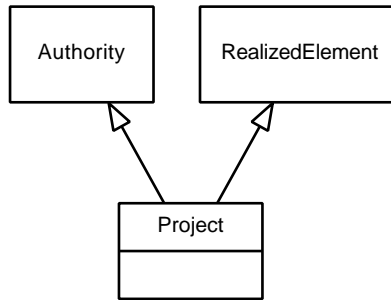


Figure 29: Class definition diagram for Project.

isResponsibilityOf [0..1] Organization
produces [0..*] Product
realizes [0..*] Project
reliesOn [0..*] DevelopedElement
supplies [0..*] mission:Mission

The class definition diagram for Project is shown in Figure 29. The class usage diagram for Project is shown in Figure 30.

5.14 Role

A *Role* corresponds to a set of assignments meant to be filled by a single *Person*.

Asserted Superclasses: base:IdentifiedElement, project-backbone:Entity

Inferred Superclasses: analysis-backbone:Aspect, analysis-backbone:Thing, analysis:AnalyzedElement, analysis:CharacterizedElement, base-backbone:Aspect, base-backbone:Thing, project-backbone:Thing

Inferred Datatype Properties: **base:hasAlternateName** [0..*] xsd:string

base:hasCanonicalName [0..1] xsd:string

base:hasDescription [0..1] xsd:string

base:hasIdentifier [0..*] xsd:string

base:hasIndexEntry [0..*] xsd:string

base:hasShortName [0..1] xsd:string

base:hasSortKey [0..1] xsd:string

base:hasUuid [0..1] xsd:string

Asserted Object Properties: **approves** [0..*] Product

concurrs [0..*] Product

delegatesTo [0..*] Role

hasAssignment [0..*] AssignedElement

isDelegateOf [0..1] Role

isRoleOf [0..1] Person

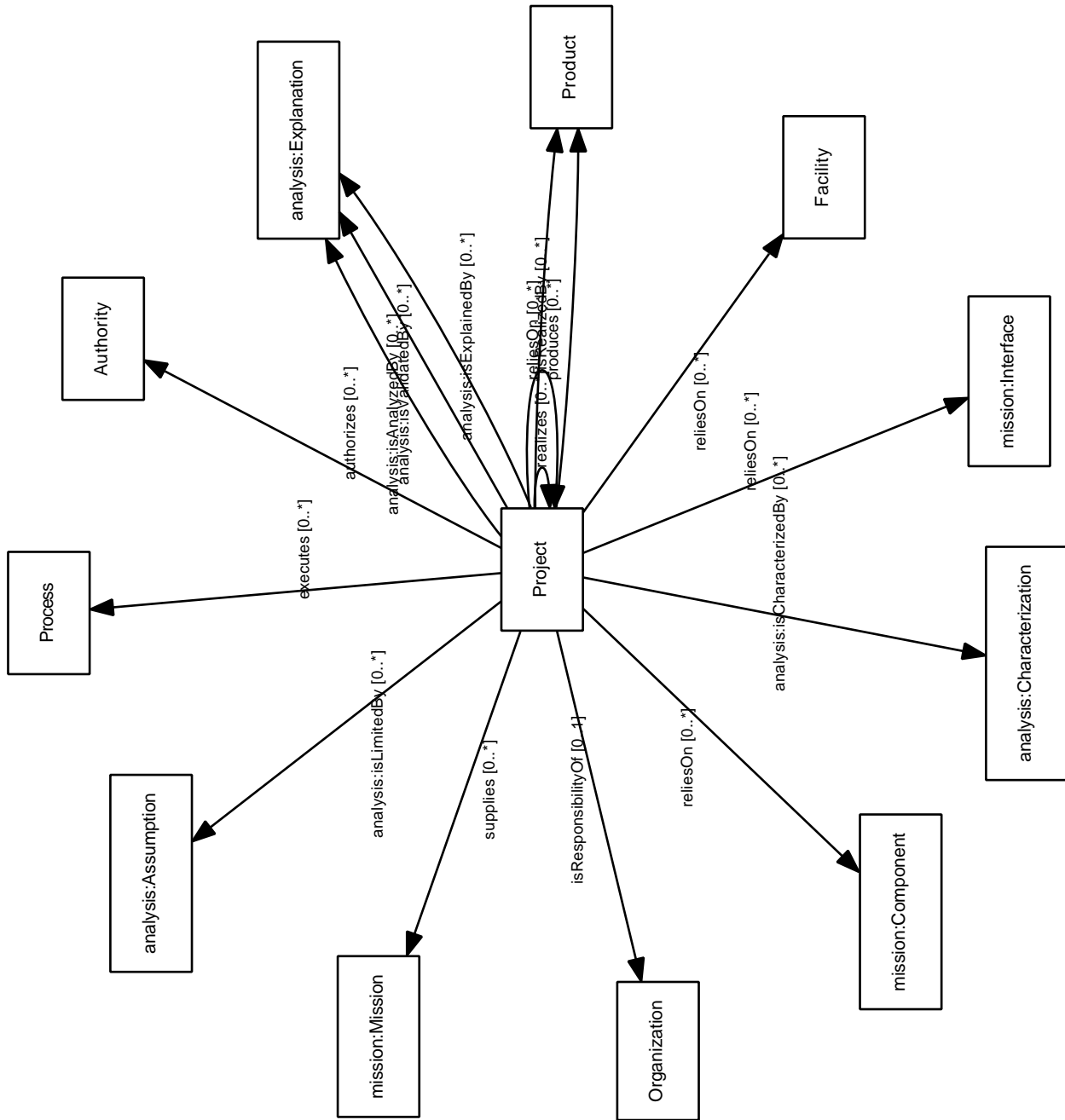


Figure 30: Class use diagram for Project.

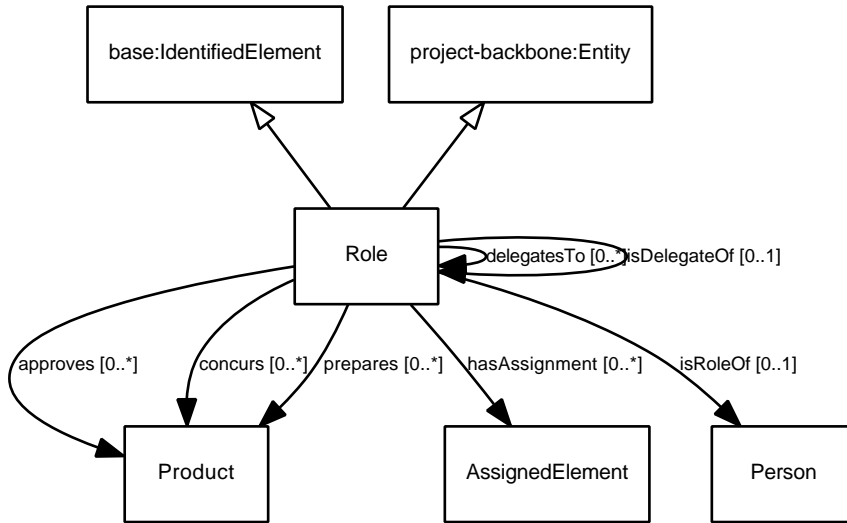


Figure 31: Class definition diagram for Role.

prepares [0..*] Product

Inferred Object Properties: **analysis:isAnalyzedBy** [0..*] analysis:Explanation

analysis:isCharacterizedBy [0..*] analysis:Characterization

analysis:isExplainedBy [0..*] analysis:Explanation

analysis:isLimitedBy [0..*] analysis:Assumption

analysis:isValidatedBy [0..*] analysis:Explanation

The class definition diagram for Role is shown in Figure 31. The class usage diagram for Role is shown in Figure 32.

5.15 Stakeholder

A *Stakeholder* is a person or organization with a recognized interest in the successful completion of a *Project* or *Program*. Example *Stakeholders* include scientists, NASA Directorates, nuclear safety advocates, and the general public.

Asserted Superclasses: base:IdentifiedElement, project-backbone:Entity

Inferred Superclasses: analysis-backbone:Aspect, analysis-backbone:Thing, analysis:AnalyzedElement, analysis:CharacterizedElement, base-backbone:Aspect, base-backbone:Thing, project-backbone:Thing

Inferred Datatype Properties: **base:hasAlternateName** [0..*] xsd:string

base:hasCanonicalName [0..1] xsd:string

base:hasDescription [0..1] xsd:string

base:hasIdentifier [0..*] xsd:string

base:hasIndexEntry [0..*] xsd:string

base:hasShortName [0..1] xsd:string

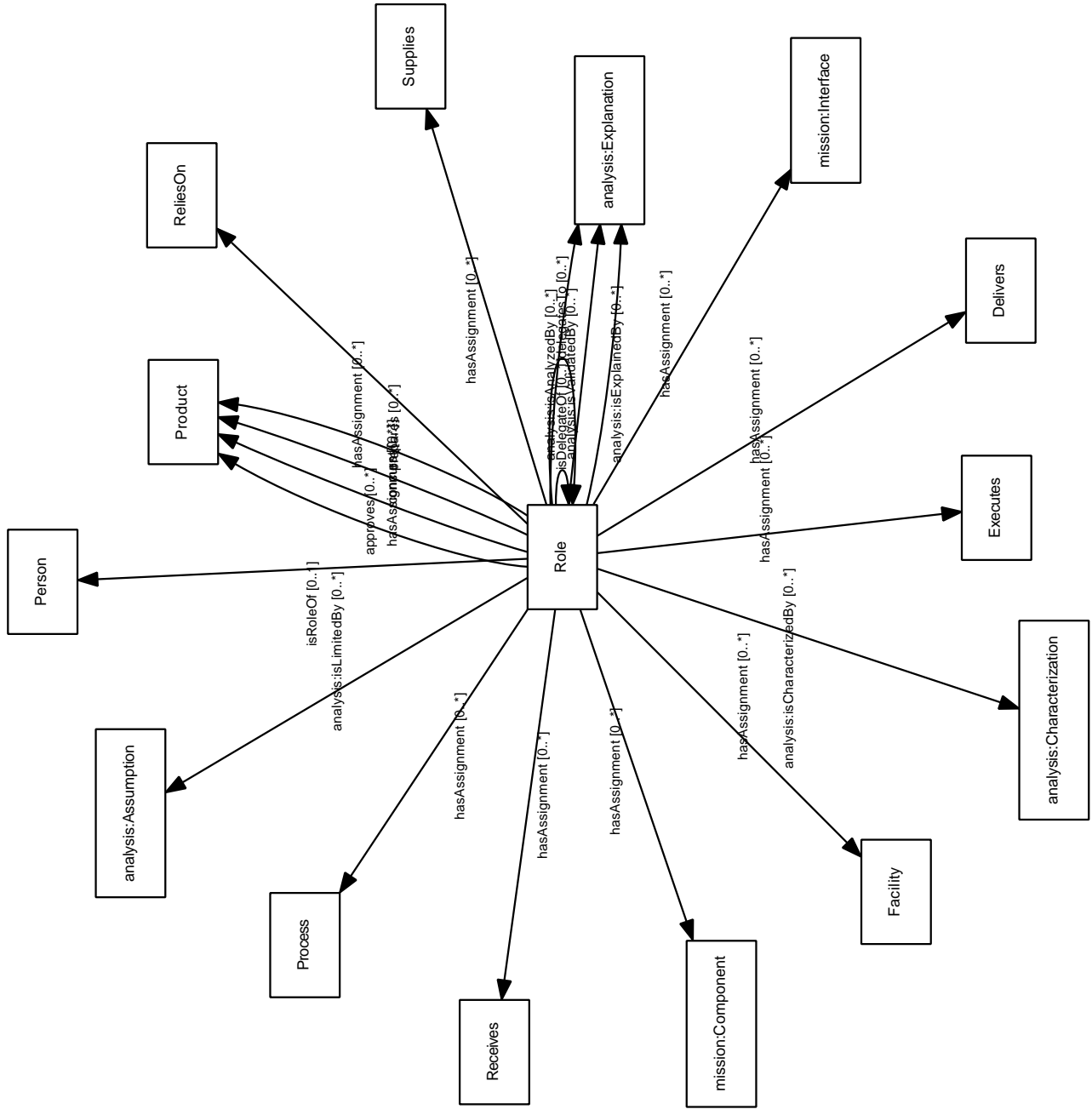


Figure 32: Class usage diagram for Role.

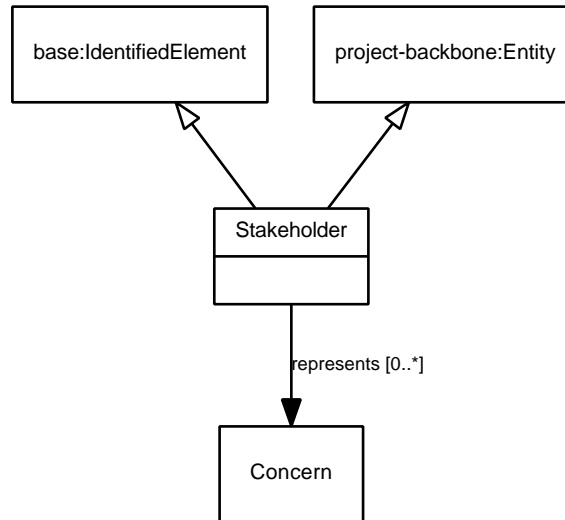


Figure 33: Class definition diagram for Stakeholder.

base:hasSortKey [0..1] xsd:string

base:hasUuid [0..1] xsd:string

Asserted Object Properties: **represents** [0..*] Concern

Inferred Object Properties: **analysis:isAnalyzedBy** [0..*] analysis:Explanation

analysis:isCharacterizedBy [0..*] analysis:Characterization

analysis:isExplainedBy [0..*] analysis:Explanation

analysis:isLimitedBy [0..*] analysis:Assumption

analysis:isValidatedBy [0..*] analysis:Explanation

The class definition diagram for Stakeholder is shown in Figure 33. The class usage diagram for Stakeholder is shown in Figure 34.

5.16 WorkPackage

A *WorkPackage* represents a discrete unit of *Project* cost, schedule, and activity. *WorkPackages* form a hierarchy called the Work Breakdown Structure.

Asserted Superclasses: Authority, base:Package, RealizedElement

Inferred Superclasses: analysis-backbone:Aspect, analysis-backbone:Thing, analysis:AnalyzedElement, analysis:CharacterizedElement, base-backbone:Aspect, base-backbone:Entity, base-backbone:Thing, base:IdentifiedElement, project-backbone:Aspect, project-backbone:Entity, project-backbone:Thing

Inferred Datatype Properties: **base:hasAlternateName** [0..*] xsd:string

base:hasCanonicalName [0..1] xsd:string

base:hasDescription [0..1] xsd:string

base:hasIdentifier [0..*] xsd:string

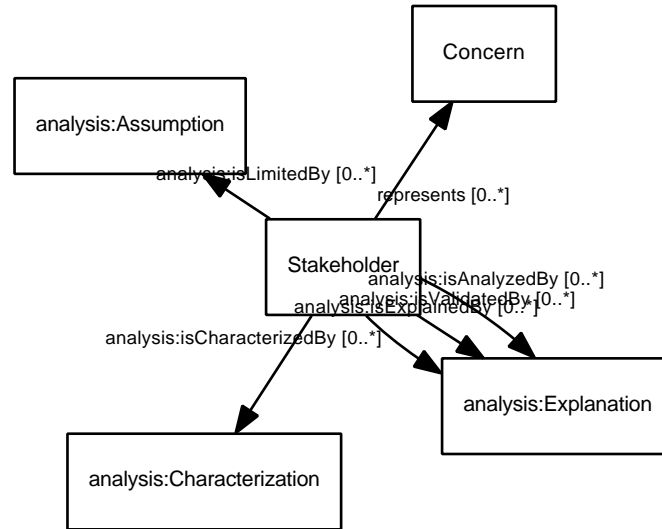


Figure 34: Class usage diagram for Stakeholder.

base:hasIndexEntry [0..*] xsd:string

base:hasShortName [0..1] xsd:string

base:hasSortKey [0..1] xsd:string

base:hasUuid [0..1] xsd:string

Inferred Object Properties: **analysis:isAnalyzedBy** [0..*] analysis:Explanation

analysis:isCharacterizedBy [0..*] analysis:Characterization

analysis:isExplainedBy [0..*] analysis:Explanation

analysis:isLimitedBy [0..*] analysis:Assumption

analysis:isValidatedBy [0..*] analysis:Explanation

authorizes [0..*] Authority

executes [0..*] Process

isRealizedBy [0..*] WorkPackage

isResponsibilityOf [0..1] Organization

produces [0..*] Product

realizes [0..*] WorkPackage

reliesOn [0..*] DevelopedElement

supplies [0..*] mission:Component

The class definition diagram for WorkPackage is shown in Figure 35. The class usage diagram for WorkPackage is shown in Figure 36.

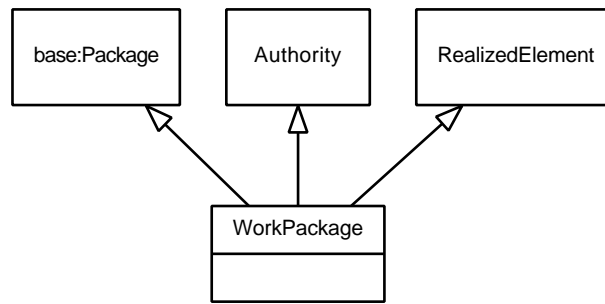


Figure 35: Class definition diagram for WorkPackage.

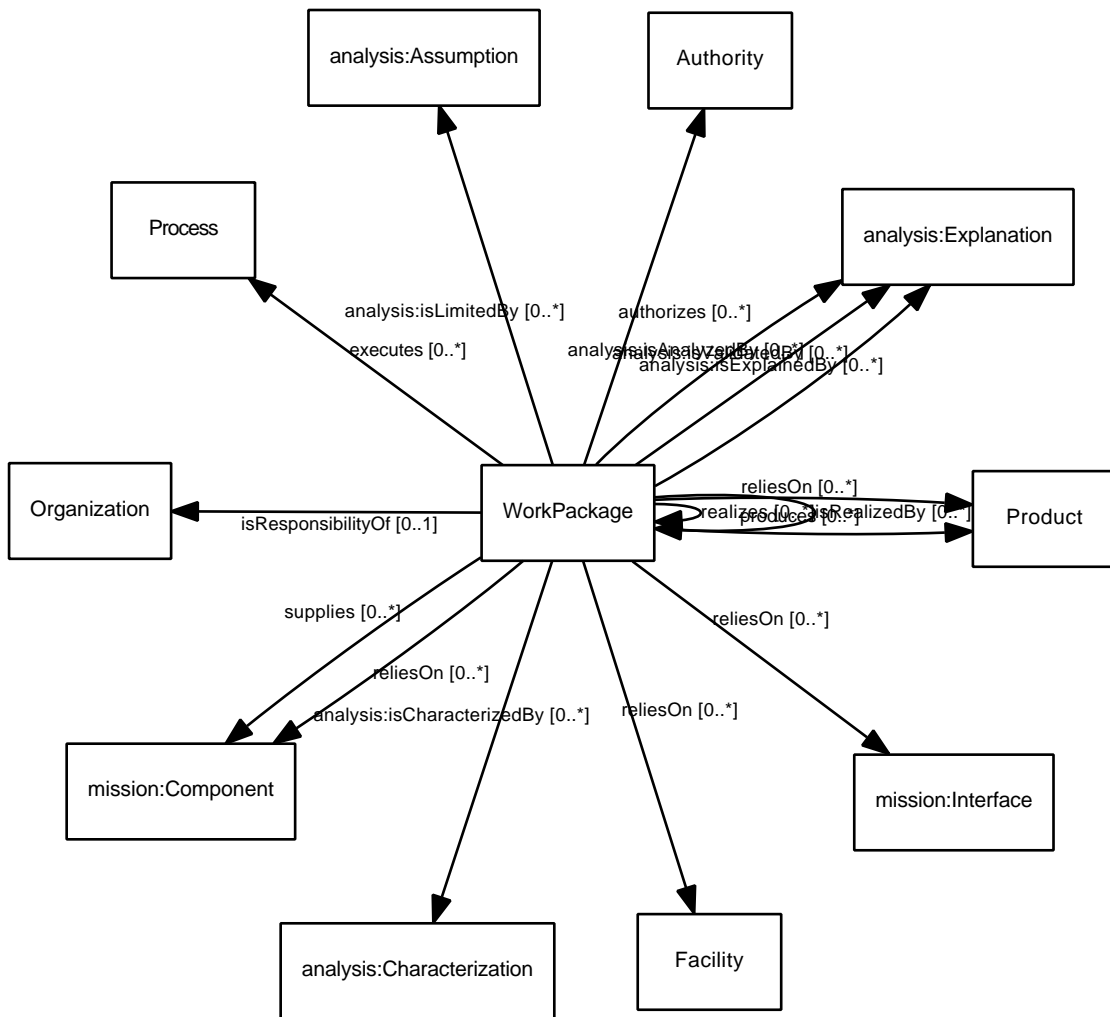


Figure 36: Class usage diagram for WorkPackage.

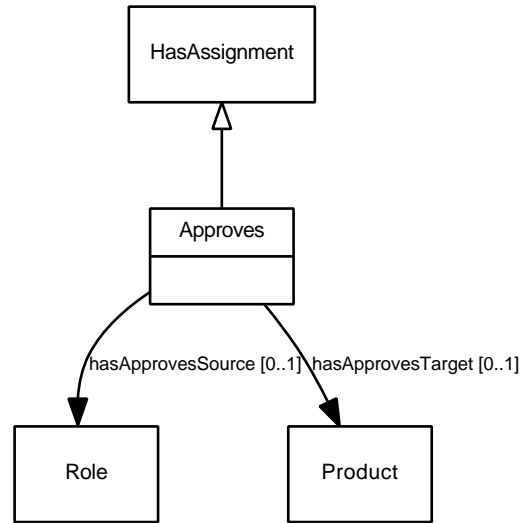


Figure 37: Class definition diagram for Approves.

6 Object Property Reification Class Definitions

6.1 Approves

Asserted Superclasses: HasAssignment

Inferred Superclasses: analysis-backbone:Aspect, analysis-backbone:Thing, analysis:AnalyzedElement, analysis:CharacterizedElement, project-backbone:ReifiedObjectProperty, project-backbone:Thing

Asserted Object Properties: **hasApprovesSource** [0..1] Role
hasApprovesTarget [0..1] Product

Inferred Object Properties: **analysis:isAnalyzedBy** [0..*] analysis:Explanation
analysis:isCharacterizedBy [0..*] analysis:Characterization
analysis:isExplainedBy [0..*] analysis:Explanation
analysis:isLimitedBy [0..*] analysis:Assumption
analysis:isValidatedBy [0..*] analysis:Explanation
hasHasAssignmentSource [0..1] Role
hasHasAssignmentTarget [0..1] AssignedElement

Reified Object Properties: approves

The class definition diagram for Approves is shown in Figure 37. The class usage diagram for Approves is shown in Figure 38.

6.2 Authorizes

Asserted Superclasses: project-backbone:ReifiedObjectProperty

Inferred Superclasses: analysis-backbone:Aspect, analysis-backbone:Thing, analysis:AnalyzedElement, analysis:CharacterizedElement, project-backbone:Thing

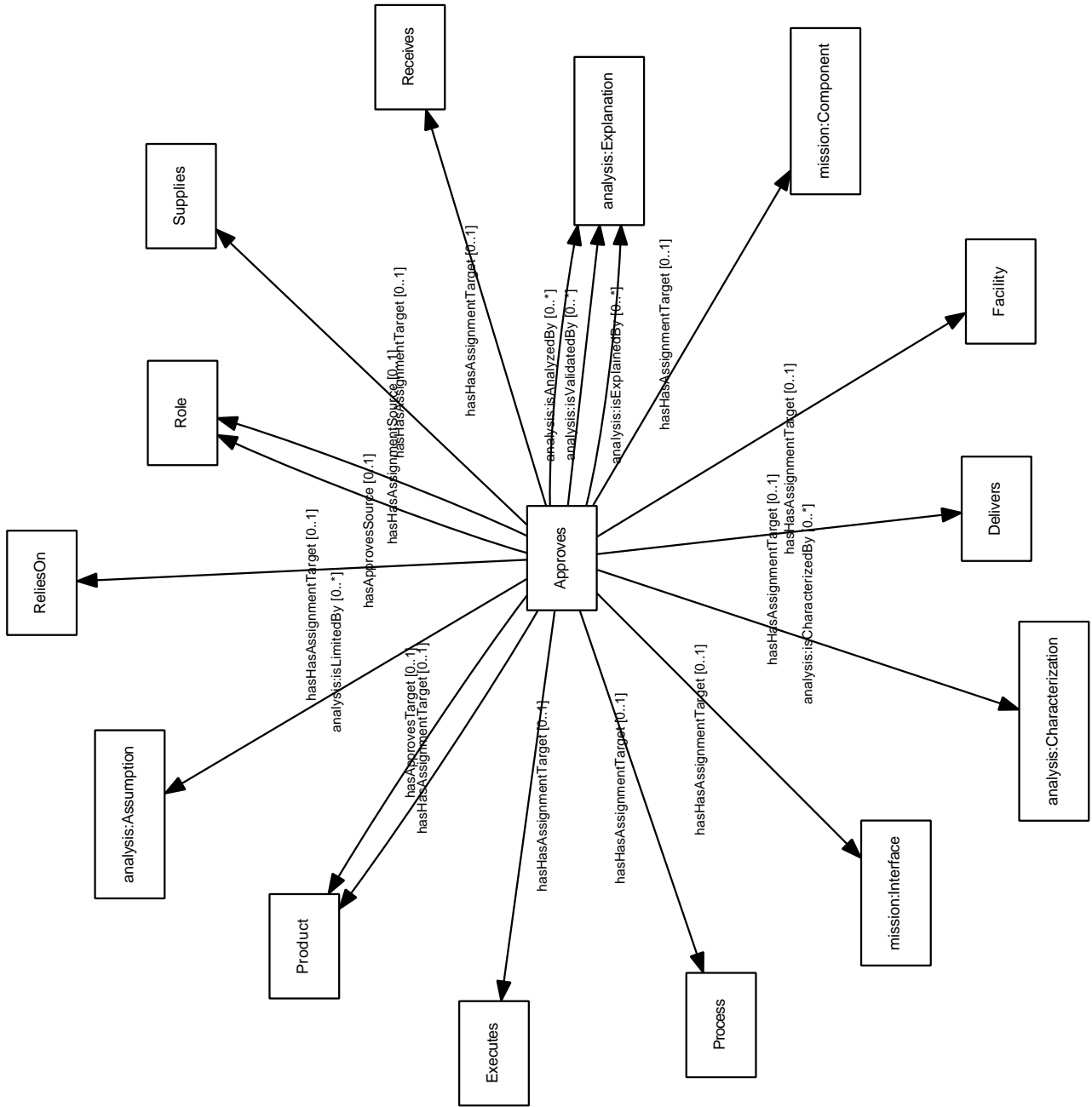


Figure 38: Class usage diagram for Approves.

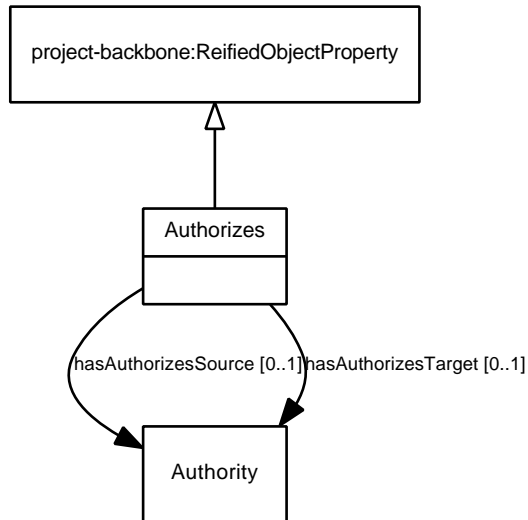


Figure 39: Class definition diagram for Authorizes.

Asserted Object Properties: **hasAuthorizesSource** [0..1] Authority
hasAuthorizesTarget [0..1] Authority

Inferred Object Properties: **analysis:isAnalyzedBy** [0..*] analysis:Explanation
analysis:isCharacterizedBy [0..*] analysis:Characterization
analysis:isExplainedBy [0..*] analysis:Explanation
analysis:isLimitedBy [0..*] analysis:Assumption
analysis:isValidatedBy [0..*] analysis:Explanation

Reified Object Properties: **authorizes**

The class definition diagram for Authorizes is shown in Figure 39. The class usage diagram for Authorizes is shown in Figure 40.

6.3 *BelongsTo*

Asserted Superclasses: project-backbone:ReifiedObjectProperty

Inferred Superclasses: analysis-backbone:Aspect, analysis-backbone:Thing, analysis:AnalyzedElement, analysis:CharacterizedElement, project-backbone:Thing

Asserted Object Properties: **hasBelongsToSource** [0..1] Person
hasBelongsToTarget [0..1] Organization

Inferred Object Properties: **analysis:isAnalyzedBy** [0..*] analysis:Explanation
analysis:isCharacterizedBy [0..*] analysis:Characterization
analysis:isExplainedBy [0..*] analysis:Explanation
analysis:isLimitedBy [0..*] analysis:Assumption
analysis:isValidatedBy [0..*] analysis:Explanation

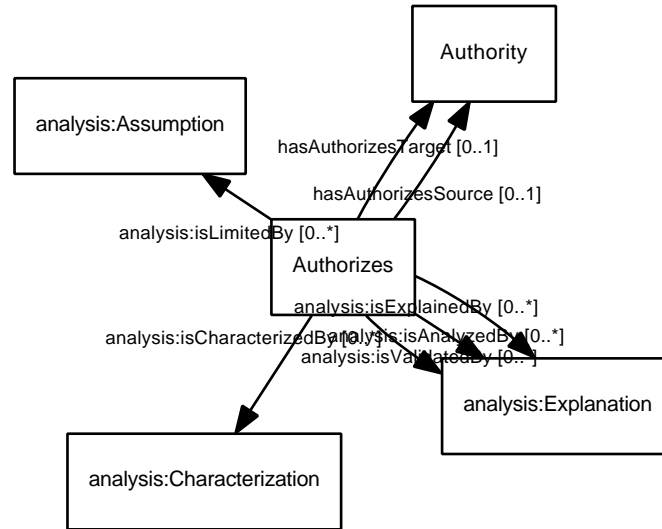


Figure 40: Class usage diagram for Authorizes.

Reified Object Properties: belongsTo

The class definition diagram for BelongsTo is shown in Figure 41. The class usage diagram for BelongsTo is shown in Figure 42.

6.4 Binds

Asserted Superclasses: project-backbone:ReifiedObjectProperty

Inferred Superclasses: analysis-backbone:Aspect, analysis-backbone:Thing, analysis:AnalyzedElement, analysis:CharacterizedElement, project-backbone:Thing

Asserted Object Properties: hasBindsSource [0..1] Policy

hasBindsTarget [0..1] mission:SpecifiedElement

Inferred Object Properties: analysis:isAnalyzedBy [0..*] analysis:Explanation

analysis:isCharacterizedBy [0..*] analysis:Characterization

analysis:isExplainedBy [0..*] analysis:Explanation

analysis:isLimitedBy [0..*] analysis:Assumption

analysis:isValidatedBy [0..*] analysis:Explanation

Reified Object Properties: binds

The class definition diagram for Binds is shown in Figure 43. The class usage diagram for Binds is shown in Figure 44.

6.5 Concurs

Asserted Superclasses: HasAssignment

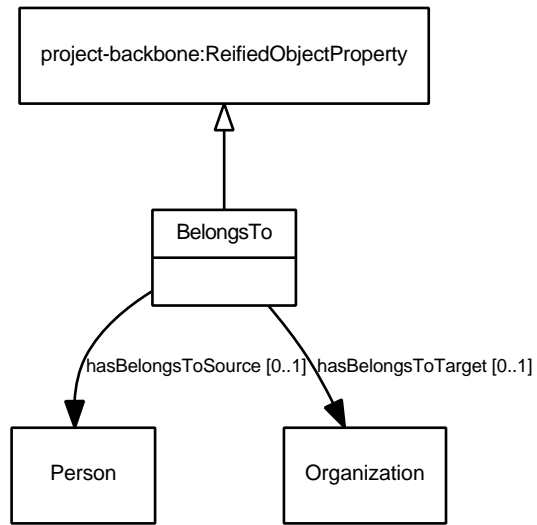


Figure 41: Class definition diagram for BelongsTo.

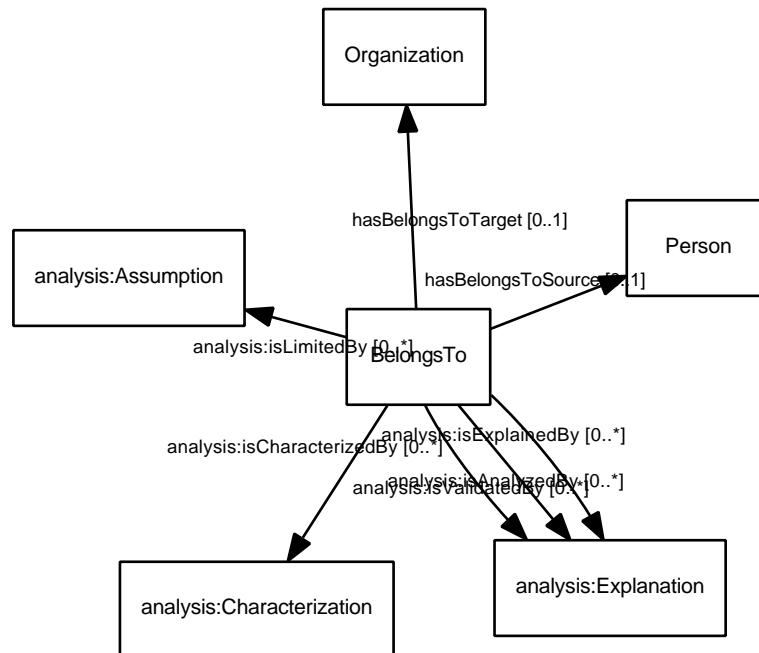


Figure 42: Class usage diagram for BelongsTo.

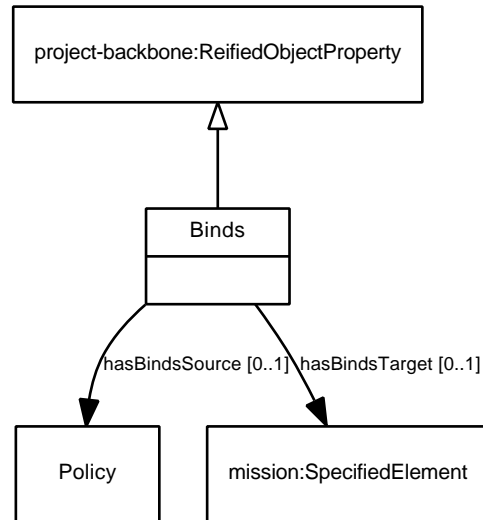


Figure 43: Class definition diagram for Binds.

Inferred Superclasses: analysis-backbone:Aspect, analysis-backbone:Thing, analysis:AnalyzedElement, analysis:CharacterizedElement, project-backbone:ReifiedObjectProperty, project-backbone:Thing

Asserted Object Properties: **hasConcursSource** [0..1] Role
hasConcursTarget [0..1] Product

Inferred Object Properties: **analysis:isAnalyzedBy** [0..*] analysis:Explanation
analysis:isCharacterizedBy [0..*] analysis:Characterization
analysis:isExplainedBy [0..*] analysis:Explanation
analysis:isLimitedBy [0..*] analysis:Assumption
analysis:isValidatedBy [0..*] analysis:Explanation
hasHasAssignmentSource [0..1] Role
hasHasAssignmentTarget [0..1] AssignedElement

Reified Object Properties: concurs

The class definition diagram for Concurs is shown in Figure 45. The class usage diagram for Concurs is shown in Figure 46.

6.6 DelegatesTo

Asserted Superclasses: project-backbone:ReifiedObjectProperty

Inferred Superclasses: analysis-backbone:Aspect, analysis-backbone:Thing, analysis:AnalyzedElement, analysis:CharacterizedElement, project-backbone:Thing

Asserted Object Properties: **hasDelegatesToSource** [0..1] Role
hasDelegatesToTarget [0..1] Role

Inferred Object Properties: **analysis:isAnalyzedBy** [0..*] analysis:Explanation

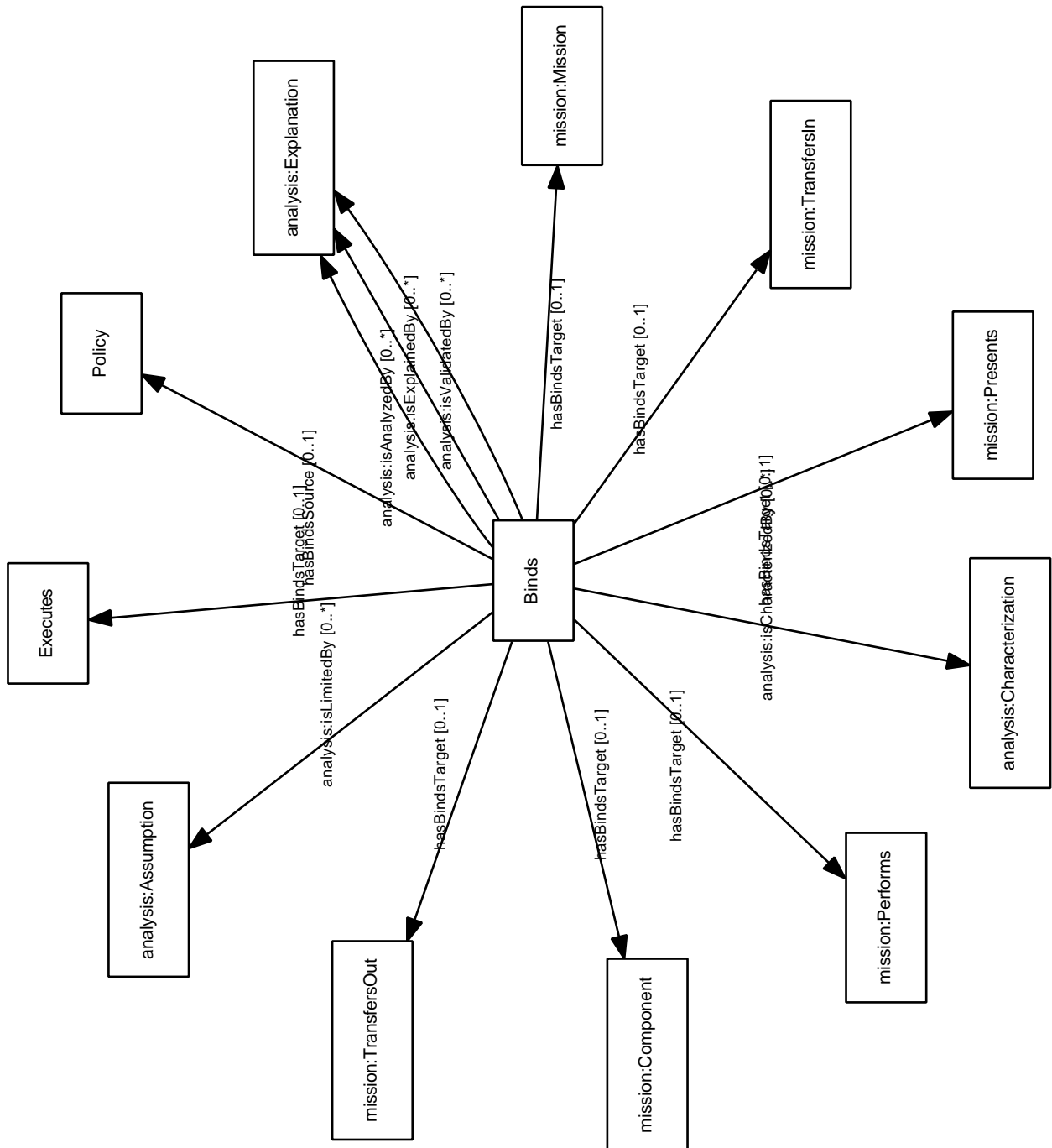


Figure 44: Class usage diagram for Bind.

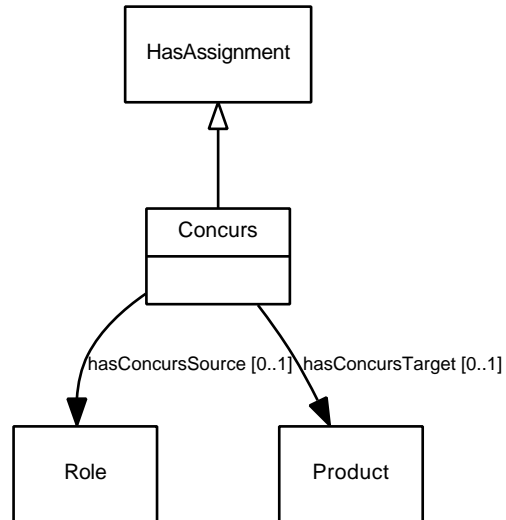


Figure 45: Class definition diagram for Concurs.

analysis:isCharacterizedBy [0..*] analysis:Characterization

analysis:isExplainedBy [0..*] analysis:Explanation

analysis:isLimitedBy [0..*] analysis:Assumption

analysis:isValidatedBy [0..*] analysis:Explanation

Reified Object Properties: delegatesTo

The class definition diagram for DelegatesTo is shown in Figure 47. The class usage diagram for DelegatesTo is shown in Figure 48.

6.7 Delivers

Asserted Superclasses: AssignedElement, project-backbone:ReifiedObjectProperty

Inferred Superclasses: analysis-backbone:Aspect, analysis-backbone:Thing, analysis:AnalyzedElement, analysis:CharacterizedElement, project-backbone:Aspect, project-backbone:Thing

Asserted Object Properties: **hasDeliversSource** [0..1] Process

hasDeliversTarget [0..1] Deliverable

Inferred Object Properties: **analysis:isAnalyzedBy** [0..*] analysis:Explanation

analysis:isCharacterizedBy [0..*] analysis:Characterization

analysis:isExplainedBy [0..*] analysis:Explanation

analysis:isLimitedBy [0..*] analysis:Assumption

analysis:isValidatedBy [0..*] analysis:Explanation

isAssignedTo [0..*] Role

Reified Object Properties: delivers

The class definition diagram for Delivers is shown in Figure 49. The class usage diagram for Delivers is shown in Figure 50.

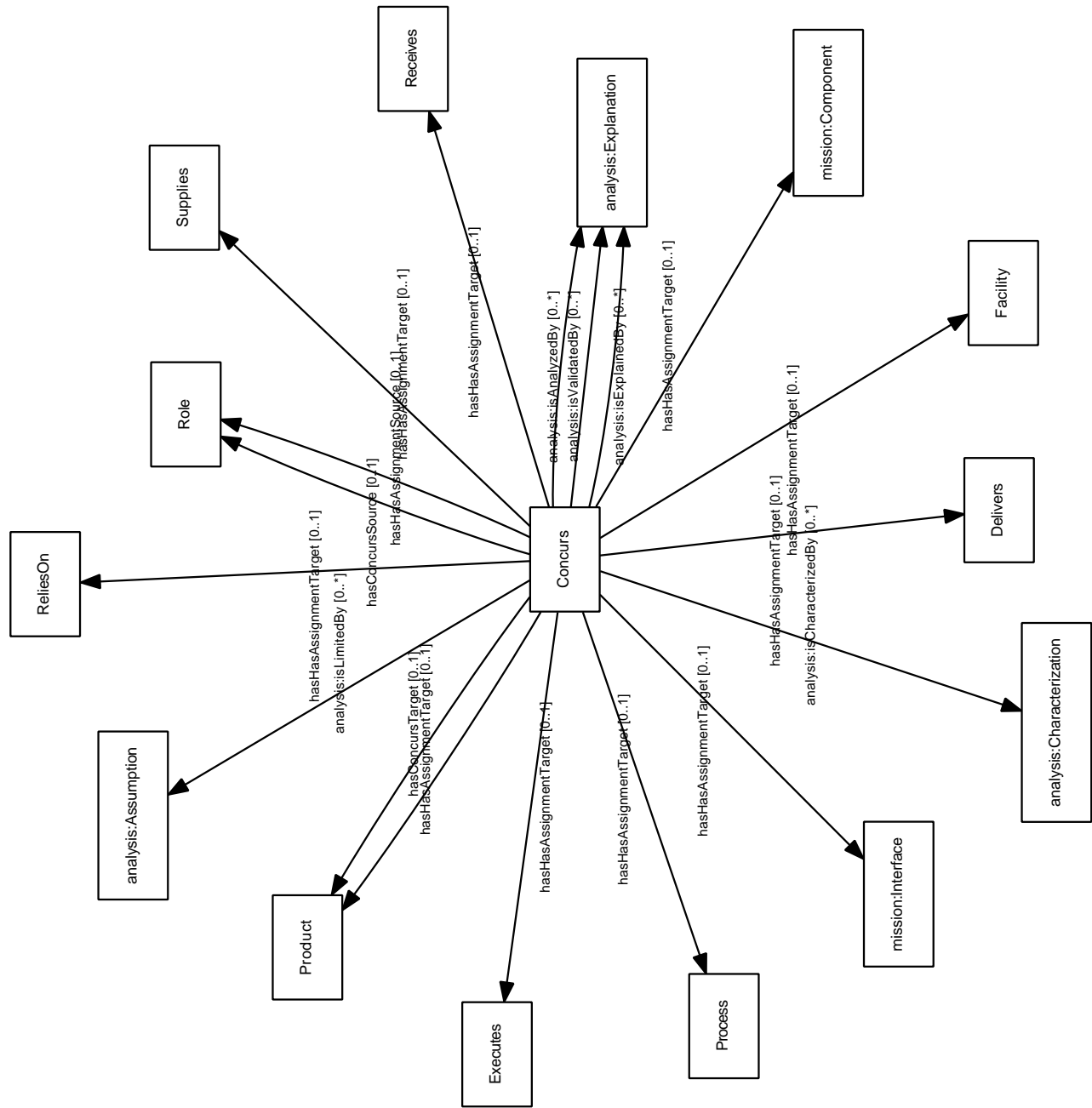


Figure 46: Class usage diagram for Conkurs.

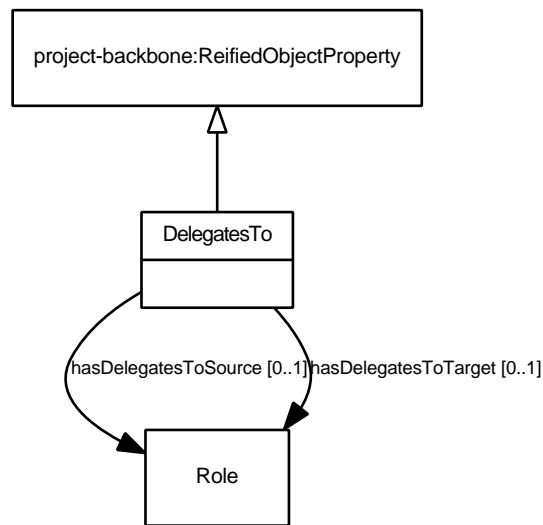


Figure 47: Class definition diagram for DelegatesTo.

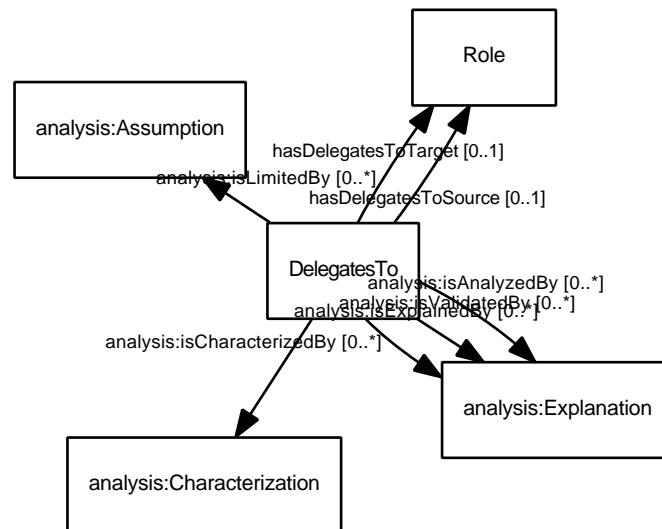


Figure 48: Class usage diagram for DelegatesTo.

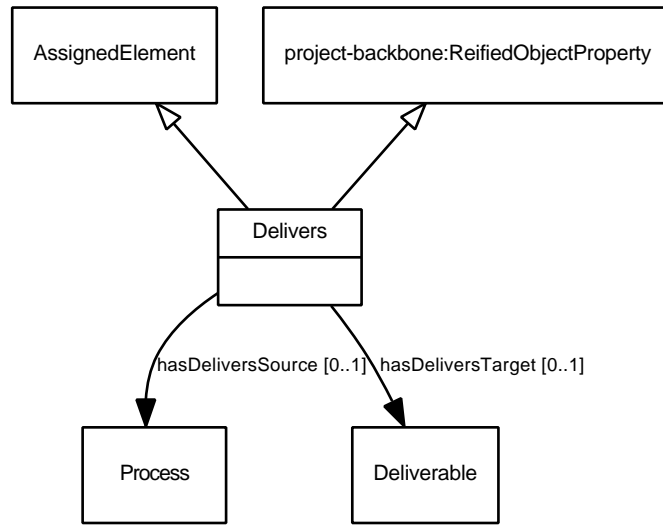


Figure 49: Class definition diagram for Delivers.

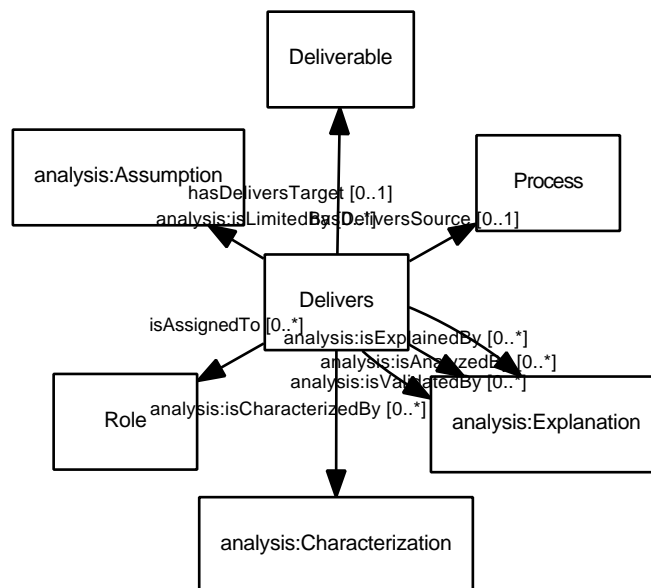


Figure 50: Class usage diagram for Delivers.

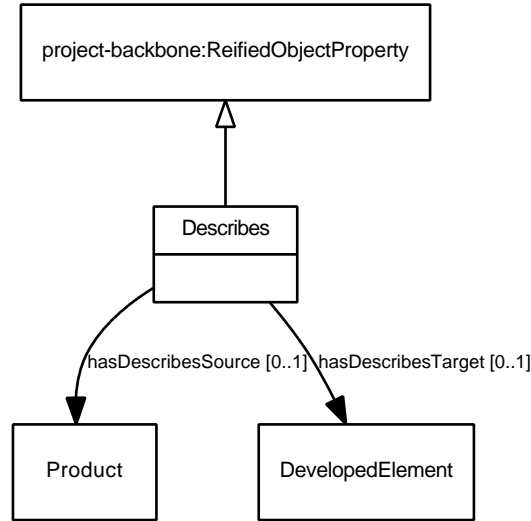


Figure 51: Class definition diagram for Describes.

6.8 Describes

Asserted Superclasses: project-backbone:ReifiedObjectProperty

Inferred Superclasses: analysis-backbone:Aspect, analysis-backbone:Thing, analysis:AnalyzedElement, analysis:CharacterizedElement, project-backbone:Thing

Asserted Object Properties: **hasDescribesSource** [0..1] Product
hasDescribesTarget [0..1] DevelopedElement

Inferred Object Properties: **analysis:isAnalyzedBy** [0..*] analysis:Explanation
analysis:isCharacterizedBy [0..*] analysis:Characterization
analysis:isExplainedBy [0..*] analysis:Explanation
analysis:isLimitedBy [0..*] analysis:Assumption
analysis:isValidatedBy [0..*] analysis:Explanation

Reified Object Properties: describes

The class definition diagram for Describes is shown in Figure 51. The class usage diagram for Describes is shown in Figure 52.

6.9 Executes

Asserted Superclasses: AssignedElement, mission:SpecifiedElement, project-backbone:ReifiedObjectProperty

Inferred Superclasses: analysis-backbone:Aspect, analysis-backbone:Thing, analysis:AnalyzedElement, analysis:CharacterizedElement, mission-backbone:Aspect, mission-backbone:Thing, project-backbone:Aspect, project-backbone:Thing

Asserted Object Properties: **hasExecutesSource** [0..1] Authority

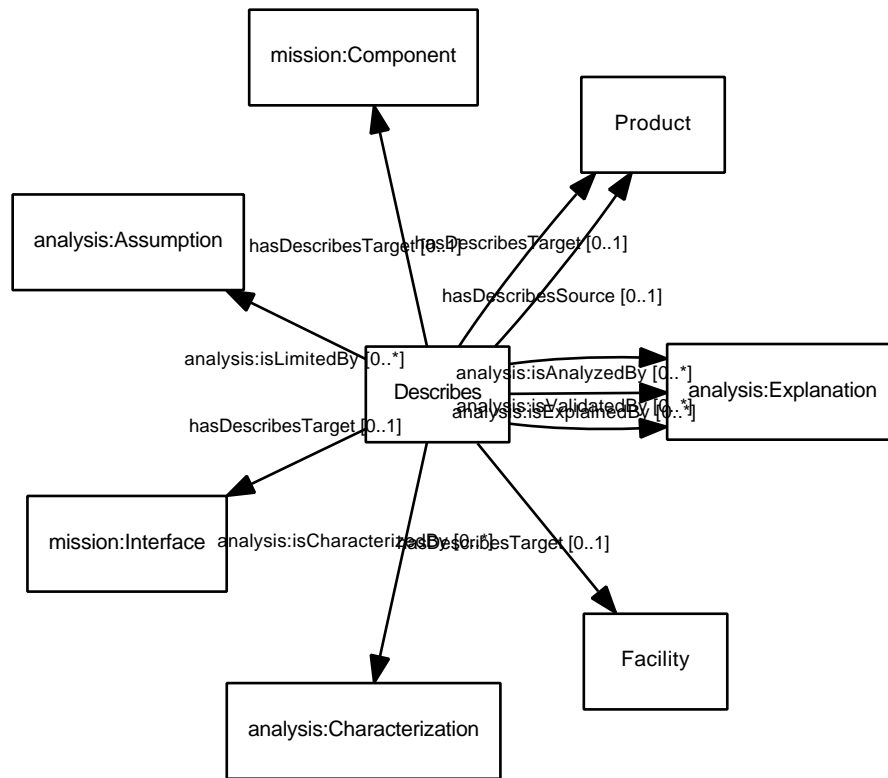


Figure 52: Class usage diagram for Describes.

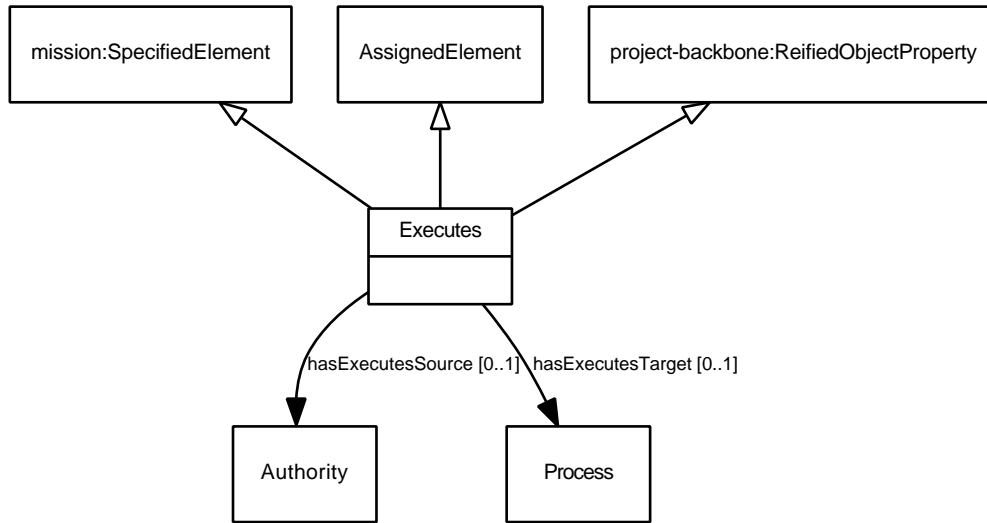


Figure 53: Class definition diagram for Executes.

hasExecutesTarget [0..1] Process

Inferred Object Properties: **analysis:isAnalyzedBy** [0..*] analysis:Explanation

analysis:isCharacterizedBy [0..*] analysis:Characterization

analysis:isExplainedBy [0..*] analysis:Explanation

analysis:isLimitedBy [0..*] analysis:Assumption

analysis:isQuantifiedBy [0..*] analysis:Quantity

analysis:isValidatedBy [0..*] analysis:Explanation

isAssignedTo [0..*] Role

isBoundBy [0..*] Policy

mission:isSpecifiedBy [0..*] mission:Requirement

Reified Object Properties: executes

The class definition diagram for Executes is shown in Figure 53. The class usage diagram for Executes is shown in Figure 54.

6.10 HasAssignment

Asserted Superclasses: project-backbone:ReifiedObjectProperty

Inferred Superclasses: analysis-backbone:Aspect, analysis-backbone:Thing, analysis:AnalyzedElement, analysis:CharacterizedElement, project-backbone:Thing

Asserted Subclasses: Approves, Concurs, Prepares

Asserted Object Properties: **hasHasAssignmentSource** [0..1] Role

hasHasAssignmentTarget [0..1] AssignedElement

Inferred Object Properties: **analysis:isAnalyzedBy** [0..*] analysis:Explanation

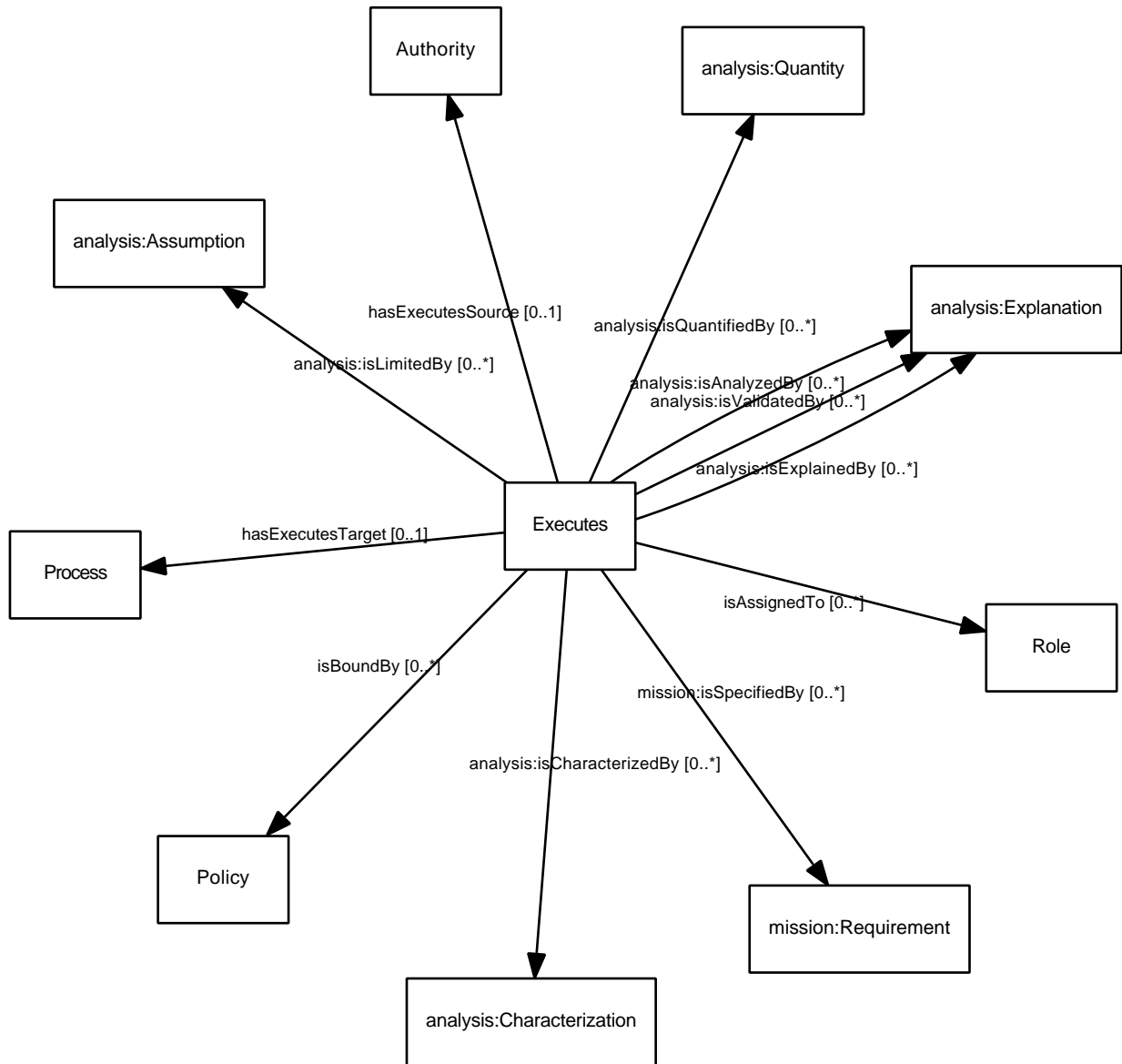


Figure 54: Class usage diagram for Executes.

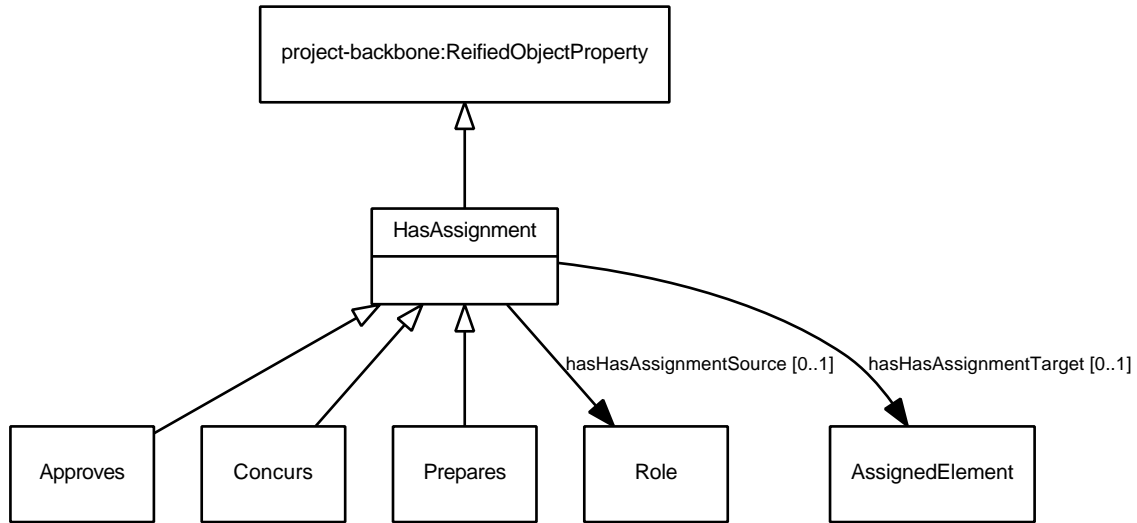


Figure 55: Class definition diagram for HasAssignment.

analysis:isCharacterizedBy [0..*] analysis:Characterization

analysis:isExplainedBy [0..*] analysis:Explanation

analysis:isLimitedBy [0..*] analysis:Assumption

analysis:isValidatedBy [0..*] analysis:Explanation

Reified Object Properties: hasAssignment

The class definition diagram for HasAssignment is shown in Figure 55. The class usage diagram for HasAssignment is shown in Figure 56.

6.11 HasParticipant

Asserted Superclasses: project-backbone:ReifiedObjectProperty

Inferred Superclasses: analysis-backbone:Aspect, analysis-backbone:Thing, analysis:AnalyzedElement, analysis:CharacterizedElement, project-backbone:Thing

Asserted Object Properties: hasHasParticipantSource [0..1] Interchange

hasHasParticipantTarget [0..1] Deliverable

Inferred Object Properties: analysis:isAnalyzedBy [0..*] analysis:Explanation

analysis:isCharacterizedBy [0..*] analysis:Characterization

analysis:isExplainedBy [0..*] analysis:Explanation

analysis:isLimitedBy [0..*] analysis:Assumption

analysis:isValidatedBy [0..*] analysis:Explanation

Reified Object Properties: hasParticipant

The class definition diagram for HasParticipant is shown in Figure 57. The class usage diagram for HasParticipant is shown in Figure 58.

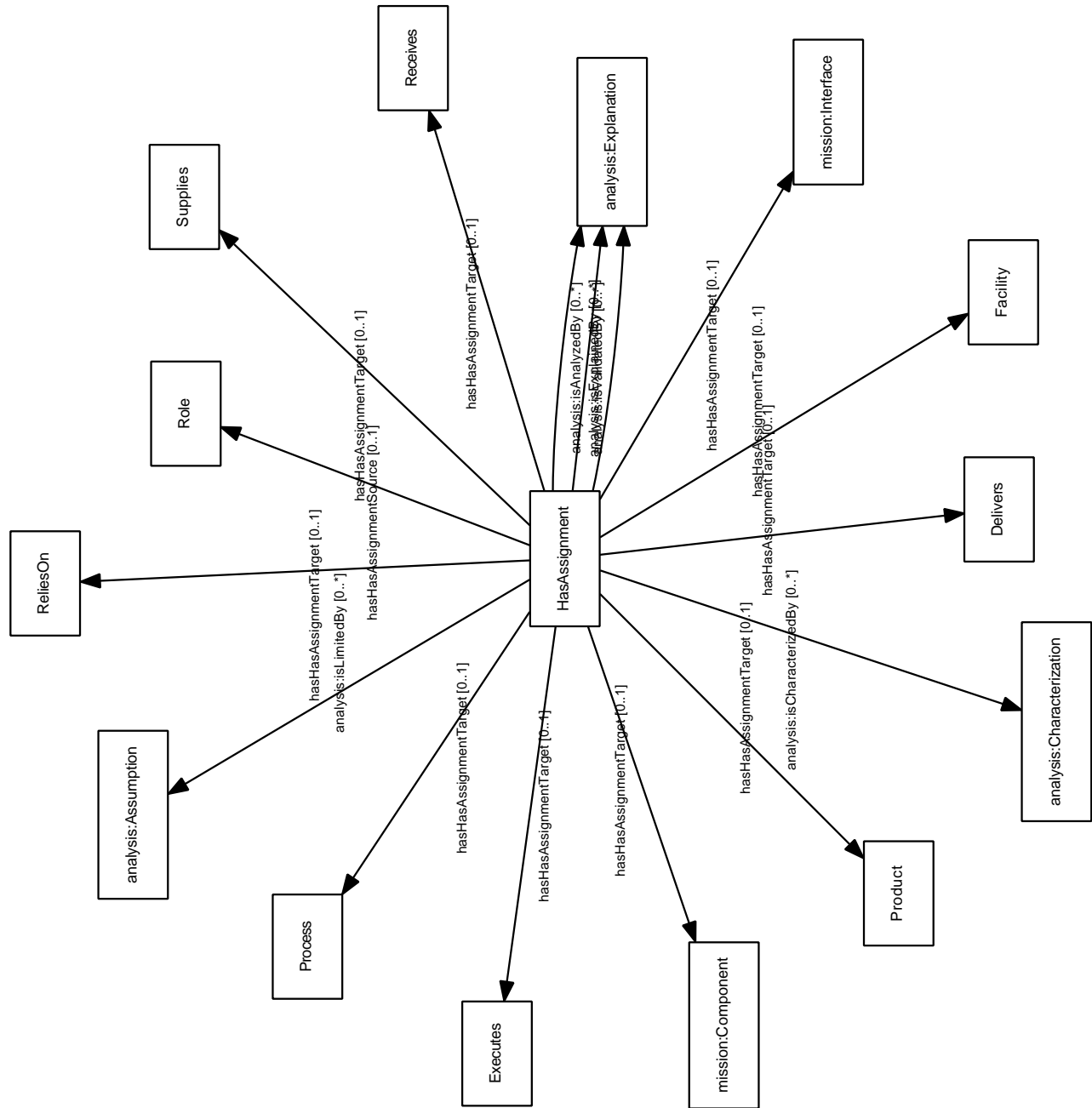


Figure 56: Class usage diagram for HasAssignment.

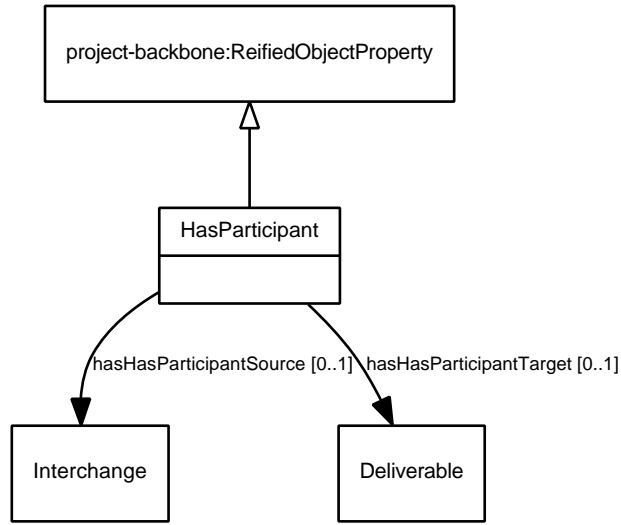


Figure 57: Class definition diagram for HasParticipant.

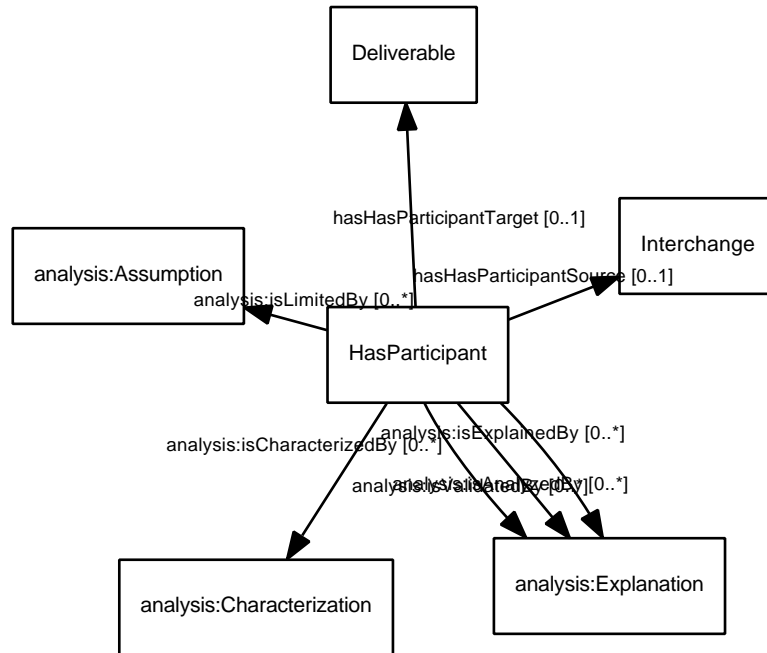


Figure 58: Class usage diagram for HasParticipant.

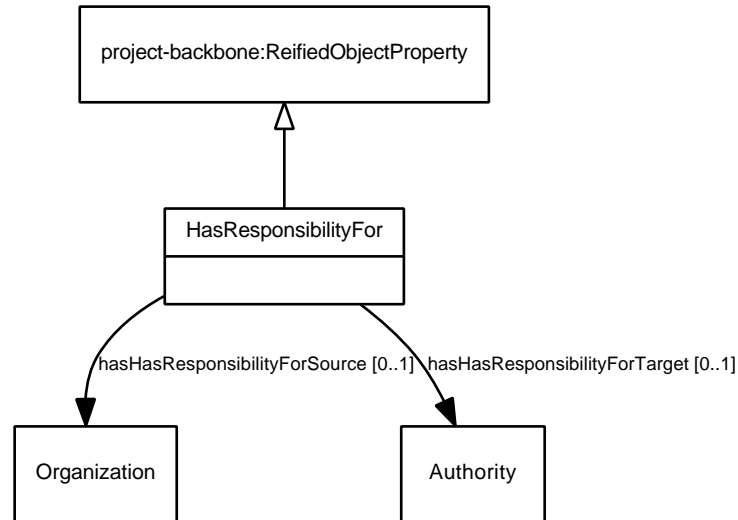


Figure 59: Class definition diagram for HasResponsibilityFor.

6.12 HasResponsibilityFor

Asserted Superclasses: project-backbone:ReifiedObjectProperty

Inferred Superclasses: analysis-backbone:Aspect, analysis-backbone:Thing, analysis:AnalyzedElement, analysis:CharacterizedElement, project-backbone:Thing

Asserted Object Properties: **hasHasResponsibilityForSource** [0..1] Organization
hasHasResponsibilityForTarget [0..1] Authority

Inferred Object Properties: **analysis:isAnalyzedBy** [0..*] analysis:Explanation
analysis:isCharacterizedBy [0..*] analysis:Characterization
analysis:isExplainedBy [0..*] analysis:Explanation
analysis:isLimitedBy [0..*] analysis:Assumption
analysis:isValidatedBy [0..*] analysis:Explanation

Reified Object Properties: hasResponsibilityFor

The class definition diagram for HasResponsibilityFor is shown in Figure 59. The class usage diagram for HasResponsibilityFor is shown in Figure 60.

6.13 HasRole

Asserted Superclasses: project-backbone:ReifiedObjectProperty

Inferred Superclasses: analysis-backbone:Aspect, analysis-backbone:Thing, analysis:AnalyzedElement, analysis:CharacterizedElement, project-backbone:Thing

Asserted Object Properties: **hasHasRoleSource** [0..1] Person
hasHasRoleTarget [0..1] Role

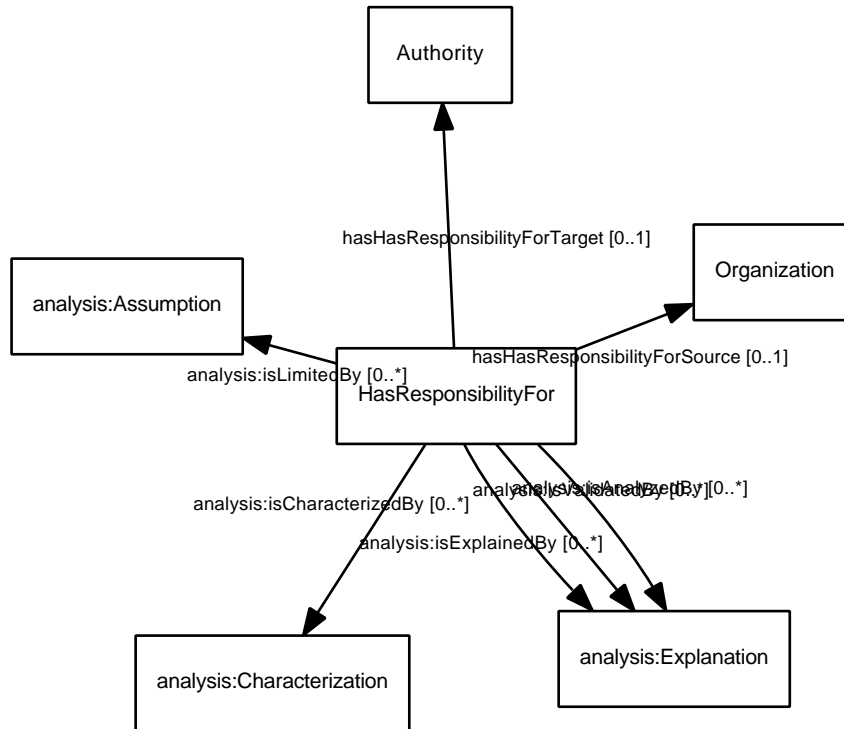


Figure 60: Class usage diagram for HasResponsibilityFor.

Inferred Object Properties: **analysis:isAnalyzedBy** [0..*] analysis:Explanation

analysis:isCharacterizedBy [0..*] analysis:Characterization

analysis:isExplainedBy [0..*] analysis:Explanation

analysis:isLimitedBy [0..*] analysis:Assumption

analysis:isValidatedBy [0..*] analysis:Explanation

Reified Object Properties: hasRole

The class definition diagram for HasRole is shown in Figure 61. The class usage diagram for HasRole is shown in Figure 62.

6.14 Invokes

Asserted Superclasses: project-backbone:ReifiedObjectProperty

Inferred Superclasses: analysis-backbone:Aspect, analysis-backbone:Thing, analysis:AnalyzedElement, analysis:CharacterizedElement, project-backbone:Thing

Asserted Object Properties: **hasInvokesSource** [0..1] Process

hasInvokesTarget [0..1] Process

Inferred Object Properties: **analysis:isAnalyzedBy** [0..*] analysis:Explanation

analysis:isCharacterizedBy [0..*] analysis:Characterization

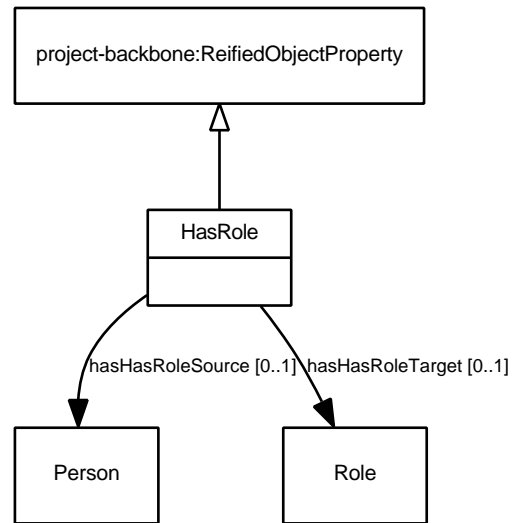


Figure 61: Class definition diagram for HasRole.

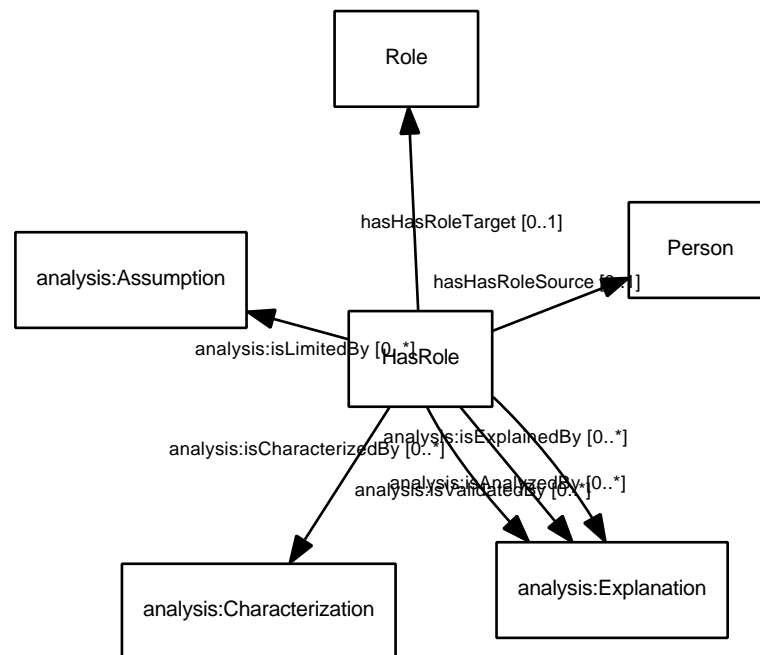


Figure 62: Class usage diagram for HasRole.

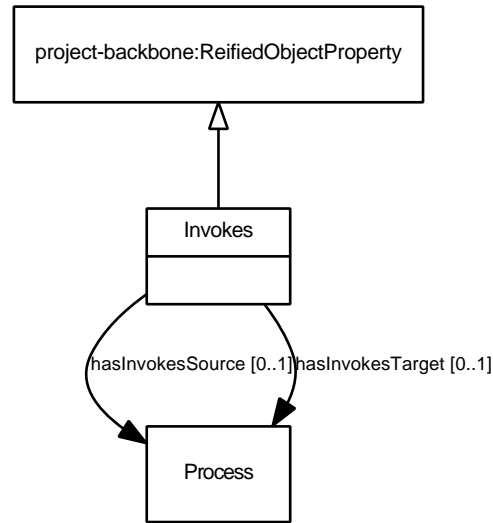


Figure 63: Class definition diagram for Invokes.

analysis:isExplainedBy [0..*] analysis:Explanation

analysis:isLimitedBy [0..*] analysis:Assumption

analysis:isValidatedBy [0..*] analysis:Explanation

Reified Object Properties: invokes

The class definition diagram for Invokes is shown in Figure 63. The class usage diagram for Invokes is shown in Figure 64.

6.15 Involves

Asserted Superclasses: project-backbone:ReifiedObjectProperty

Inferred Superclasses: analysis-backbone:Aspect, analysis-backbone:Thing, analysis:AnalyzedElement, analysis:CharacterizedElement, project-backbone:Thing

Asserted Subclasses: Involves1, Involves2

Asserted Object Properties: **hasInvokesSource** [0..1] Interchange

hasInvokesTarget [0..1] Process

Inferred Object Properties: **analysis:isAnalyzedBy** [0..*] analysis:Explanation

analysis:isCharacterizedBy [0..*] analysis:Characterization

analysis:isExplainedBy [0..*] analysis:Explanation

analysis:isLimitedBy [0..*] analysis:Assumption

analysis:isValidatedBy [0..*] analysis:Explanation

Reified Object Properties: involves

The class definition diagram for Involves is shown in Figure 65. The class usage diagram for Involves is shown in Figure 66.

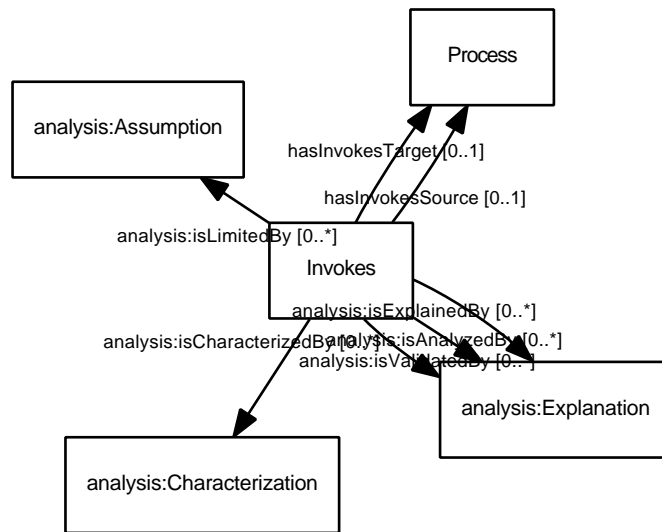


Figure 64: Class usage diagram for Involves.

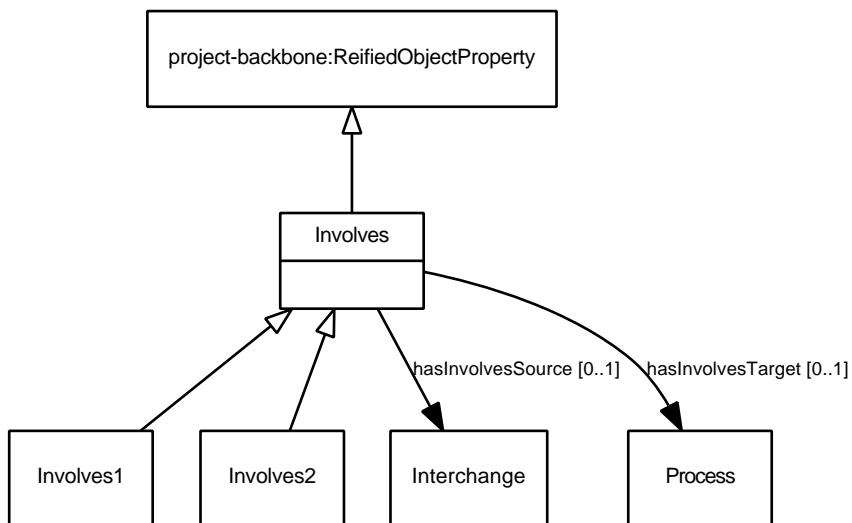


Figure 65: Class definition diagram for Involves.

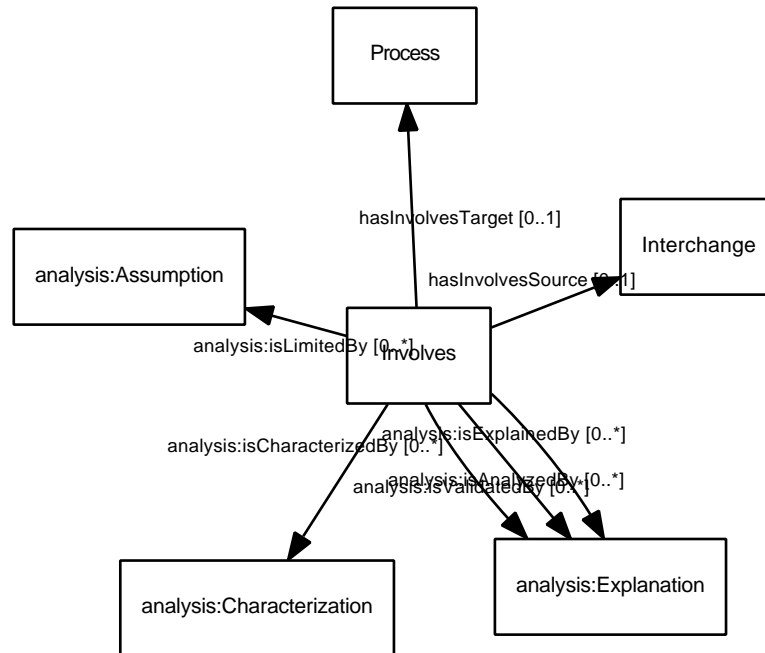


Figure 66: Class usage diagram for Involves.

6.16 Involves1

Asserted Superclasses: Involves

Inferred Superclasses: analysis-backbone:Aspect, analysis-backbone:Thing, analysis:AnalyzedElement, analysis:CharacterizedElement, project-backbone:ReifiedObjectProperty, project-backbone:Thing

Asserted Object Properties: **hasInvolvesSource** [0..1] Interchange

hasInvolvesTarget [0..1] Process

Inferred Object Properties: **analysis:isAnalyzedBy** [0..*] analysis:Explanation

analysis:isCharacterizedBy [0..*] analysis:Characterization

analysis:isExplainedBy [0..*] analysis:Explanation

analysis:isLimitedBy [0..*] analysis:Assumption

analysis:isValidatedBy [0..*] analysis:Explanation

hasInvolvesSource [0..1] Interchange

hasInvolvesTarget [0..1] Process

Reified Object Properties: involves1

The class definition diagram for Involves1 is shown in Figure 67. The class usage diagram for Involves1 is shown in Figure 68.

6.17 Involves2

Asserted Superclasses: Involves

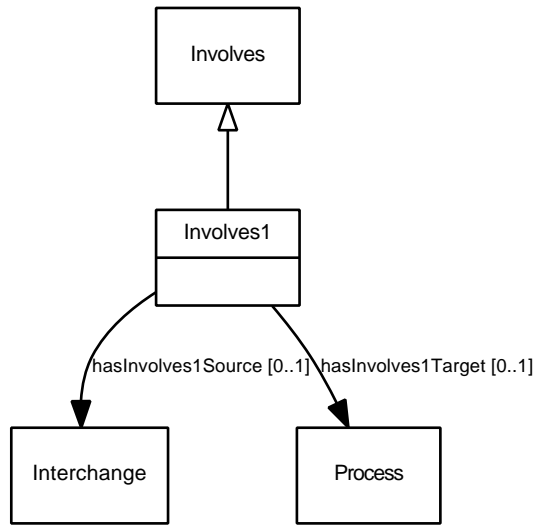


Figure 67: Class definition diagram for Involves1.

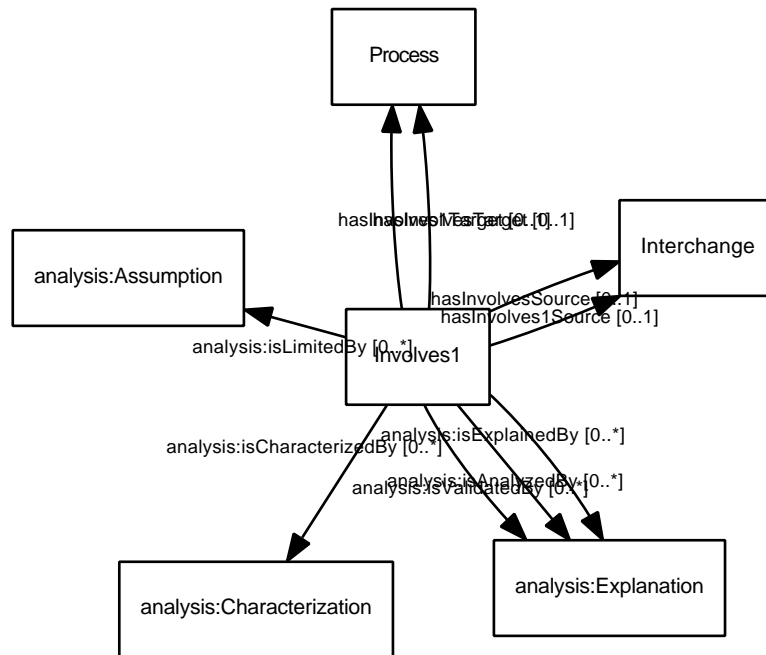


Figure 68: Class usage diagram for Involves1.

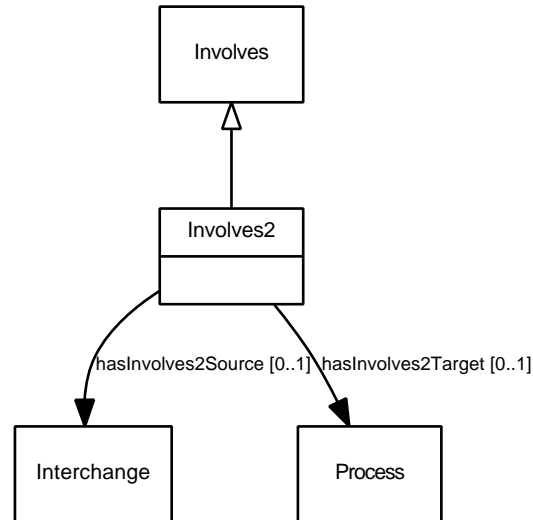


Figure 69: Class definition diagram for Involves2.

Inferred Superclasses: analysis-backbone:Aspect, analysis-backbone:Thing, analysis:AnalyzedElement, analysis:CharacterizedElement, project-backbone:ReifiedObjectProperty, project-backbone:Thing

Asserted Object Properties: **hasInvolves2Source** [0..1] Interchange
hasInvolves2Target [0..1] Process

Inferred Object Properties: **analysis:isAnalyzedBy** [0..*] analysis:Explanation
analysis:isCharacterizedBy [0..*] analysis:Characterization
analysis:isExplainedBy [0..*] analysis:Explanation
analysis:isLimitedBy [0..*] analysis:Assumption
analysis:isValidatedBy [0..*] analysis:Explanation
hasInvolvesSource [0..1] Interchange
hasInvolvesTarget [0..1] Process

Reified Object Properties: involves2

The class definition diagram for Involves2 is shown in Figure 69. The class usage diagram for Involves2 is shown in Figure 70.

6.18 Manifests

Asserted Superclasses: project-backbone:ReifiedObjectProperty

Inferred Superclasses: analysis-backbone:Aspect, analysis-backbone:Thing, analysis:AnalyzedElement, analysis:CharacterizedElement, project-backbone:Thing

Asserted Object Properties: **hasManifestsSource** [0..1] DevelopedElement
hasManifestsTarget [0..1] DevelopmentState

Inferred Object Properties: **analysis:isAnalyzedBy** [0..*] analysis:Explanation

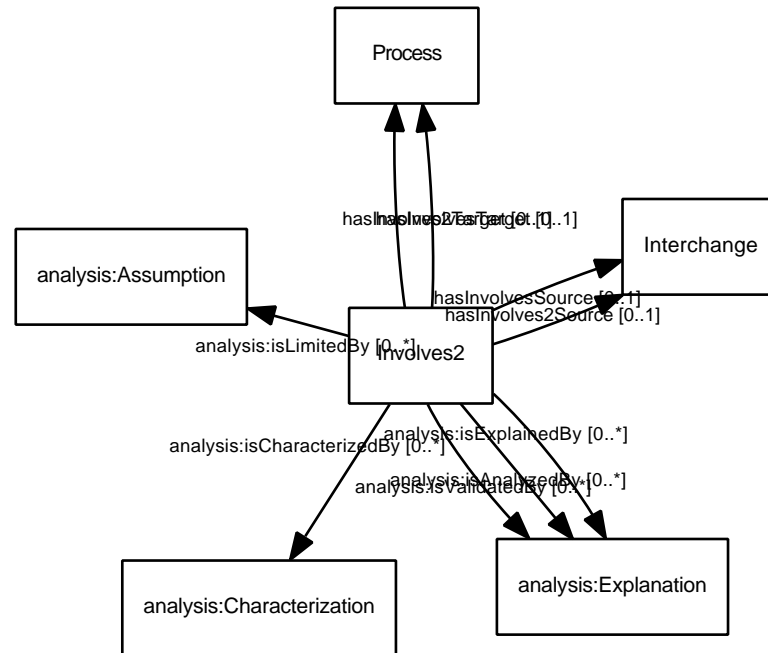


Figure 70: Class usage diagram for Involves2.

analysis:isCharacterizedBy [0..*] analysis:Characterization

analysis:isExplainedBy [0..*] analysis:Explanation

analysis:isLimitedBy [0..*] analysis:Assumption

analysis:isValidatedBy [0..*] analysis:Explanation

Reified Object Properties: manifests

The class definition diagram for Manifests is shown in Figure 71. The class usage diagram for Manifests is shown in Figure 72.

6.19 Prepares

Asserted Superclasses: HasAssignment

Inferred Superclasses: analysis-backbone:Aspect, analysis-backbone:Thing, analysis:AnalyzedElement, analysis:CharacterizedElement, project-backbone:ReifiedObjectProperty, project-backbone:Thing

Asserted Object Properties: **hasPreparesSource** [0..1] Role

hasPreparesTarget [0..1] Product

Inferred Object Properties: **analysis:isAnalyzedBy** [0..*] analysis:Explanation

analysis:isCharacterizedBy [0..*] analysis:Characterization

analysis:isExplainedBy [0..*] analysis:Explanation

analysis:isLimitedBy [0..*] analysis:Assumption

analysis:isValidatedBy [0..*] analysis:Explanation

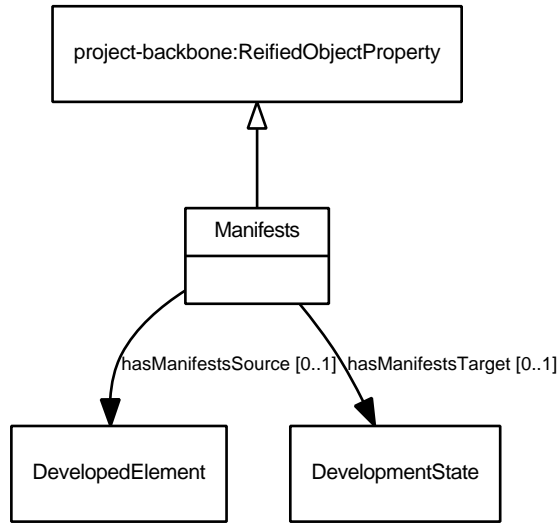


Figure 71: Class definition diagram for Manifests.

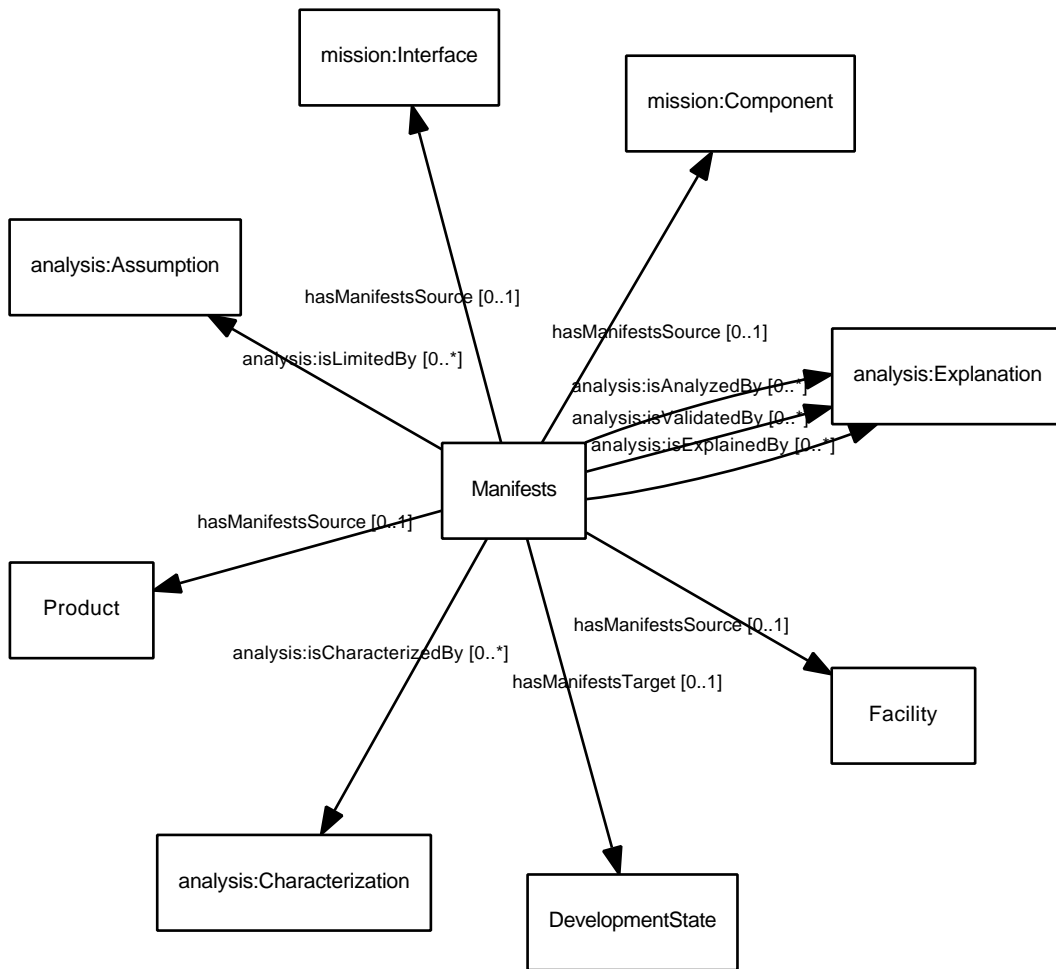


Figure 72: Class usage diagram for Manifests.

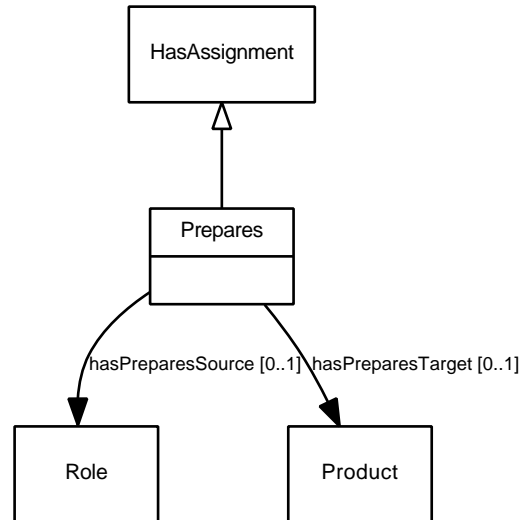


Figure 73: Class definition diagram for Prepares.

hasHasAssignmentSource [0..1] Role
hasHasAssignmentTarget [0..1] AssignedElement

Reified Object Properties: prepares

The class definition diagram for Prepares is shown in Figure 73. The class usage diagram for Prepares is shown in Figure 74.

6.20 Produces

Asserted Superclasses: Supplies

Inferred Superclasses: analysis-backbone:Aspect, analysis-backbone:Thing, analysis:AnalyzedElement, analysis:CharacterizedElement, AssignedElement, project-backbone:Aspect, project-backbone:ReifiedObjectProperty, project-backbone:Thing

Asserted Object Properties: **hasProducesSource** [0..1] Authority
hasProducesTarget [0..1] Product

Inferred Object Properties: **analysis:isAnalyzedBy** [0..*] analysis:Explanation
analysis:isCharacterizedBy [0..*] analysis:Characterization
analysis:isExplainedBy [0..*] analysis:Explanation
analysis:isLimitedBy [0..*] analysis:Assumption
analysis:isValidatedBy [0..*] analysis:Explanation
hasSuppliesSource [0..1] Authority
hasSuppliesTarget [0..1] SuppliedElement
isAssignedTo [0..*] Role

Reified Object Properties: produces

The class definition diagram for Produces is shown in Figure 75. The class usage diagram for Produces is shown in Figure 76.

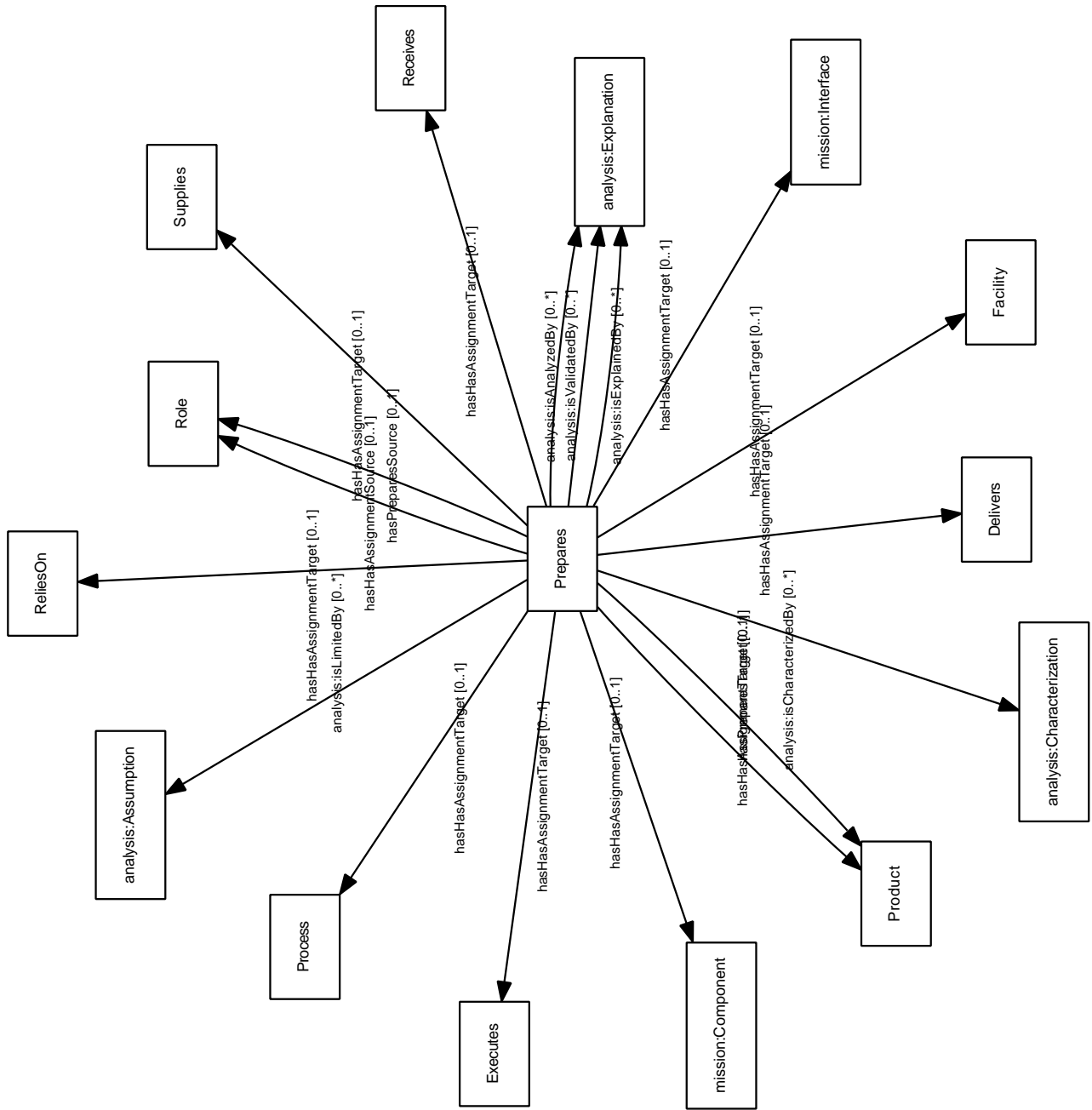


Figure 74: Class usage diagram for Prepares.

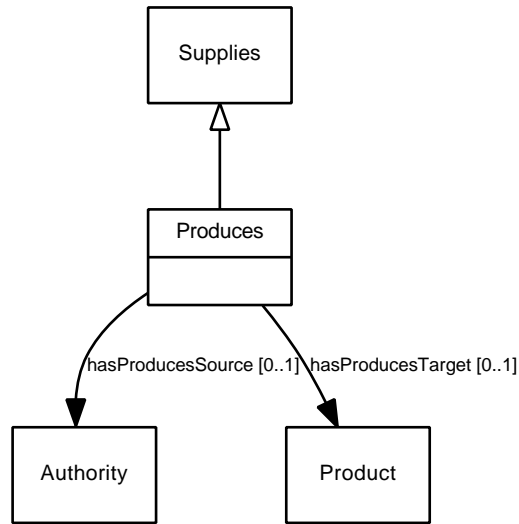


Figure 75: Class definition diagram for Produces.

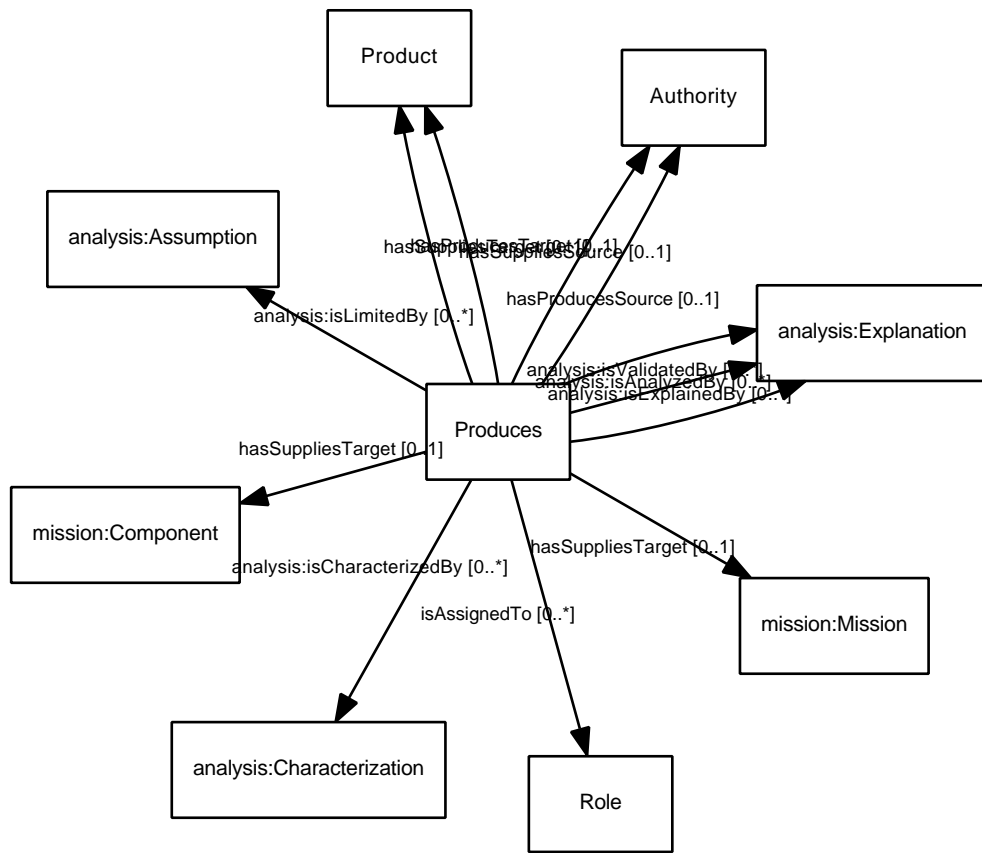


Figure 76: Class usage diagram for Produces.

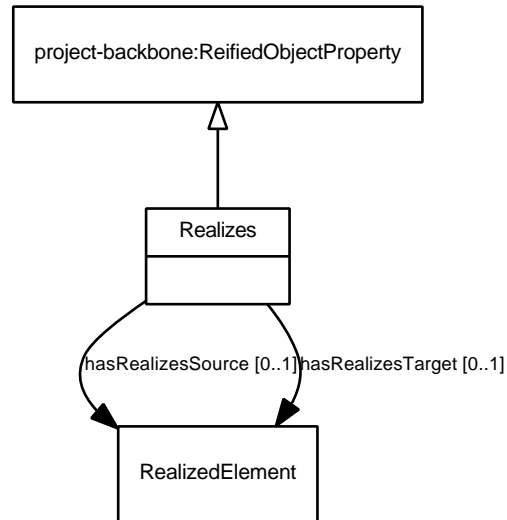


Figure 77: Class definition diagram for Realizes.

6.21 Realizes

Asserted Superclasses: project-backbone:ReifiedObjectProperty

Inferred Superclasses: analysis-backbone:Aspect, analysis-backbone:Thing, analysis:AnalyzedElement, analysis:CharacterizedElement, project-backbone:Thing

Asserted Object Properties: **hasRealizesSource** [0..1] RealizedElement
hasRealizesTarget [0..1] RealizedElement

Inferred Object Properties: **analysis:isAnalyzedBy** [0..*] analysis:Explanation
analysis:isCharacterizedBy [0..*] analysis:Characterization
analysis:isExplainedBy [0..*] analysis:Explanation
analysis:isLimitedBy [0..*] analysis:Assumption
analysis:isValidatedBy [0..*] analysis:Explanation

Reified Object Properties: realizes

The class definition diagram for Realizes is shown in Figure 77. The class usage diagram for Realizes is shown in Figure 78.

6.22 Receives

Asserted Superclasses: AssignedElement, project-backbone:ReifiedObjectProperty

Inferred Superclasses: analysis-backbone:Aspect, analysis-backbone:Thing, analysis:AnalyzedElement, analysis:CharacterizedElement, project-backbone:Aspect, project-backbone:Thing

Asserted Object Properties: **hasReceivesSource** [0..1] Process
hasReceivesTarget [0..1] Deliverable

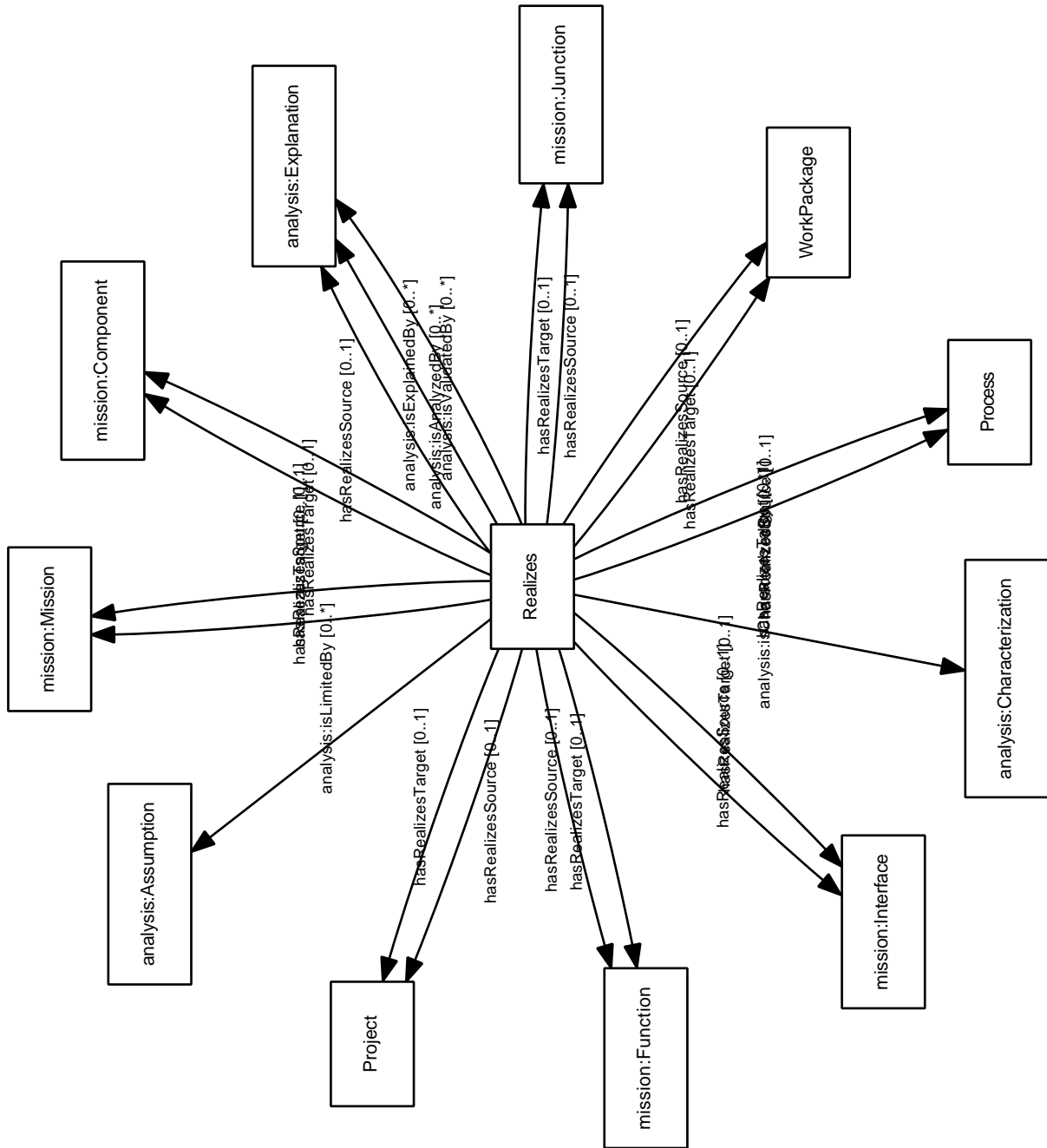


Figure 78: Class usage diagram for Realizes.

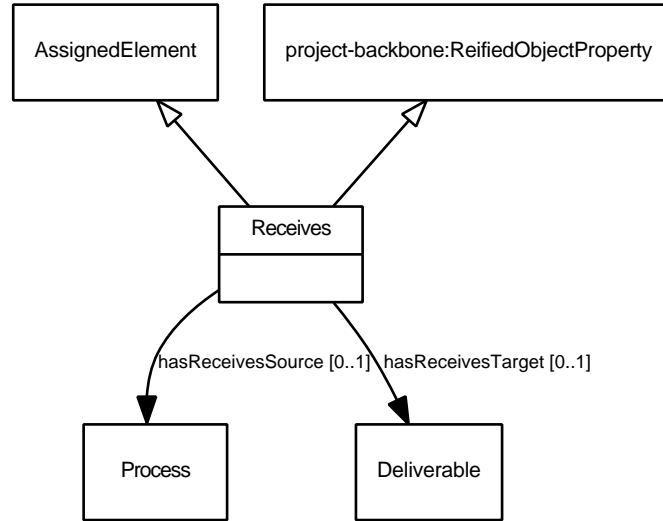


Figure 79: Class definition diagram for Receives.

Inferred Object Properties: **analysis:isAnalyzedBy** [0..*] analysis:Explanation
analysis:isCharacterizedBy [0..*] analysis:Characterization
analysis:isExplainedBy [0..*] analysis:Explanation
analysis:isLimitedBy [0..*] analysis:Assumption
analysis:isValidatedBy [0..*] analysis:Explanation
isAssignedTo [0..*] Role

Reified Object Properties: receives

The class definition diagram for Receives is shown in Figure 79. The class usage diagram for Receives is shown in Figure 80.

6.23 ReliesOn

Asserted Superclasses: AssignedElement, project-backbone:ReifiedObjectProperty

Inferred Superclasses: analysis-backbone:Aspect, analysis-backbone:Thing, analysis:AnalyzedElement, analysis:CharacterizedElement, project-backbone:Aspect, project-backbone:Thing

Asserted Object Properties: **hasReliesOnSource** [0..1] Authority
hasReliesOnTarget [0..1] DevelopedElement

Inferred Object Properties: **analysis:isAnalyzedBy** [0..*] analysis:Explanation
analysis:isCharacterizedBy [0..*] analysis:Characterization
analysis:isExplainedBy [0..*] analysis:Explanation
analysis:isLimitedBy [0..*] analysis:Assumption
analysis:isValidatedBy [0..*] analysis:Explanation
isAssignedTo [0..*] Role

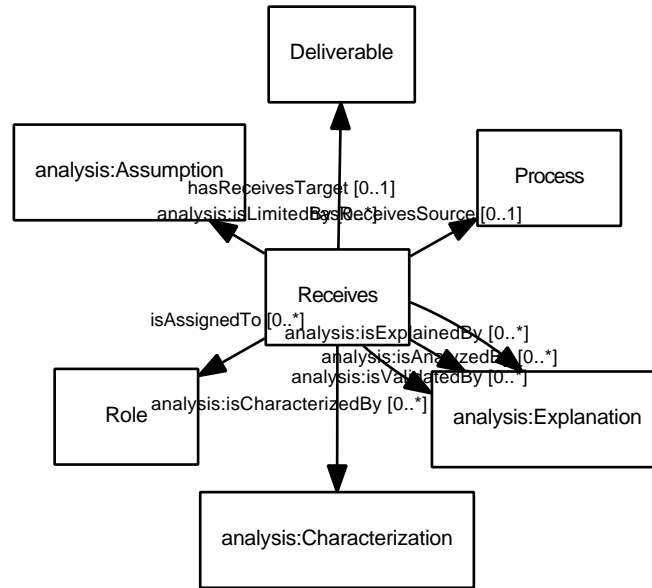


Figure 80: Class usage diagram for Receives.

Reified Object Properties: reliesOn

The class definition diagram for ReliesOn is shown in Figure 81. The class usage diagram for ReliesOn is shown in Figure 82.

6.24 Represents

Asserted Superclasses: project-backbone:ReifiedObjectProperty

Inferred Superclasses: analysis-backbone:Aspect, analysis-backbone:Thing, analysis:AnalyzedElement, analysis:CharacterizedElement, project-backbone:Thing

Asserted Object Properties: **hasRepresentsSource** [0..1] Stakeholder
hasRepresentsTarget [0..1] Concern

Inferred Object Properties: **analysis:isAnalyzedBy** [0..*] analysis:Explanation
analysis:isCharacterizedBy [0..*] analysis:Characterization
analysis:isExplainedBy [0..*] analysis:Explanation
analysis:isLimitedBy [0..*] analysis:Assumption
analysis:isValidatedBy [0..*] analysis:Explanation

Reified Object Properties: represents

The class definition diagram for Represents is shown in Figure 83. The class usage diagram for Represents is shown in Figure 84.

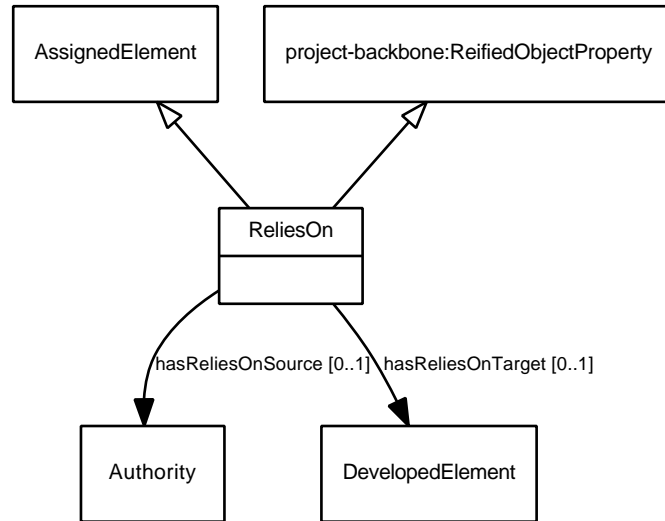


Figure 81: Class definition diagram for ReliesOn.

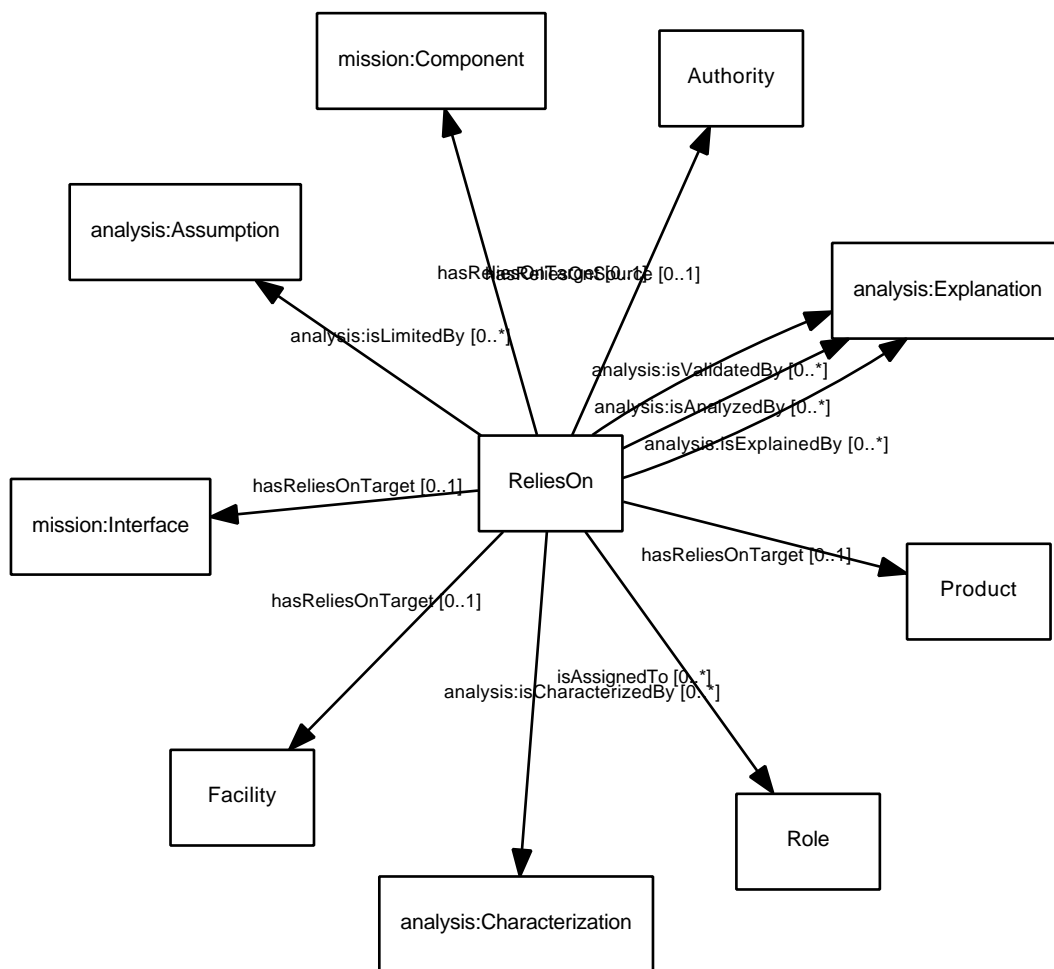


Figure 82: Class usage diagram for ReliesOn.

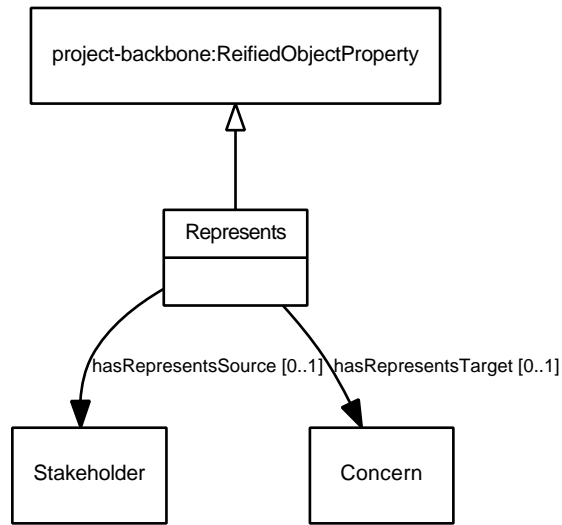


Figure 83: Class definition diagram for Represents.

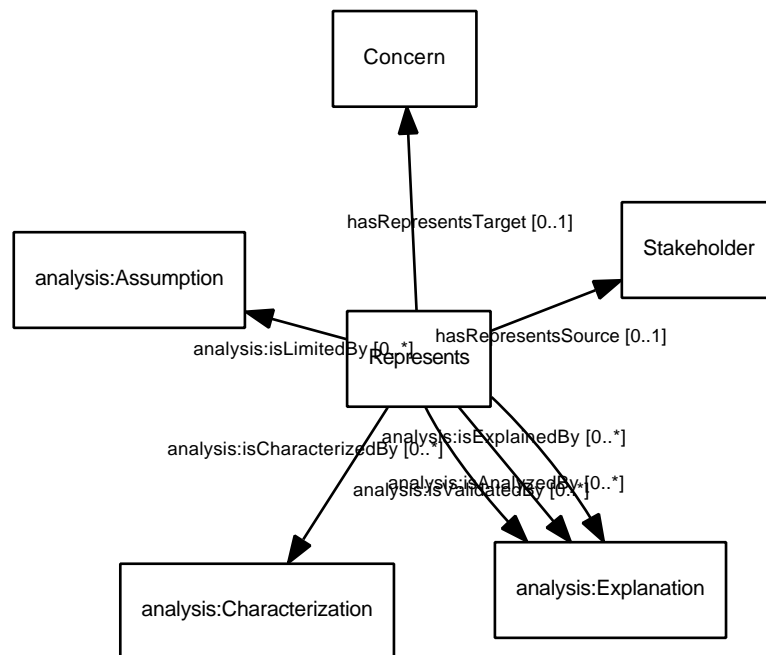


Figure 84: Class usage diagram for Represents.

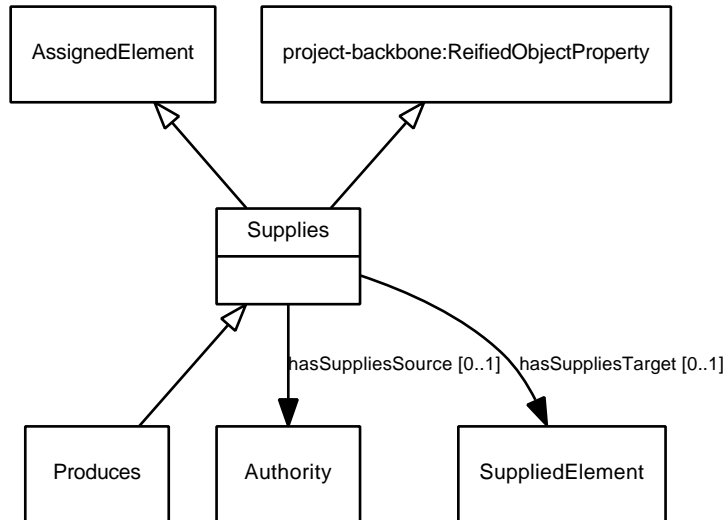


Figure 85: Class definition diagram for Supplies.

6.25 Supplies

Asserted Superclasses: AssignedElement, project-backbone:ReifiedObjectProperty

Inferred Superclasses: analysis-backbone:Aspect, analysis-backbone:Thing, analysis:AnalyzedElement, analysis:CharacterizedElement, project-backbone:Aspect, project-backbone:Thing

Asserted Subclasses: Produces

Asserted Object Properties: hasSuppliesSource [0..1] Authority
hasSuppliesTarget [0..1] SuppliedElement

Inferred Object Properties: analysis:isAnalyzedBy [0..*] analysis:Explanation
analysis:isCharacterizedBy [0..*] analysis:Characterization
analysis:isExplainedBy [0..*] analysis:Explanation
analysis:isLimitedBy [0..*] analysis:Assumption
analysis:isValidatedBy [0..*] analysis:Explanation
isAssignedTo [0..*] Role

Reified Object Properties: supplies

The class definition diagram for Supplies is shown in Figure 85. The class usage diagram for Supplies is shown in Figure 86.

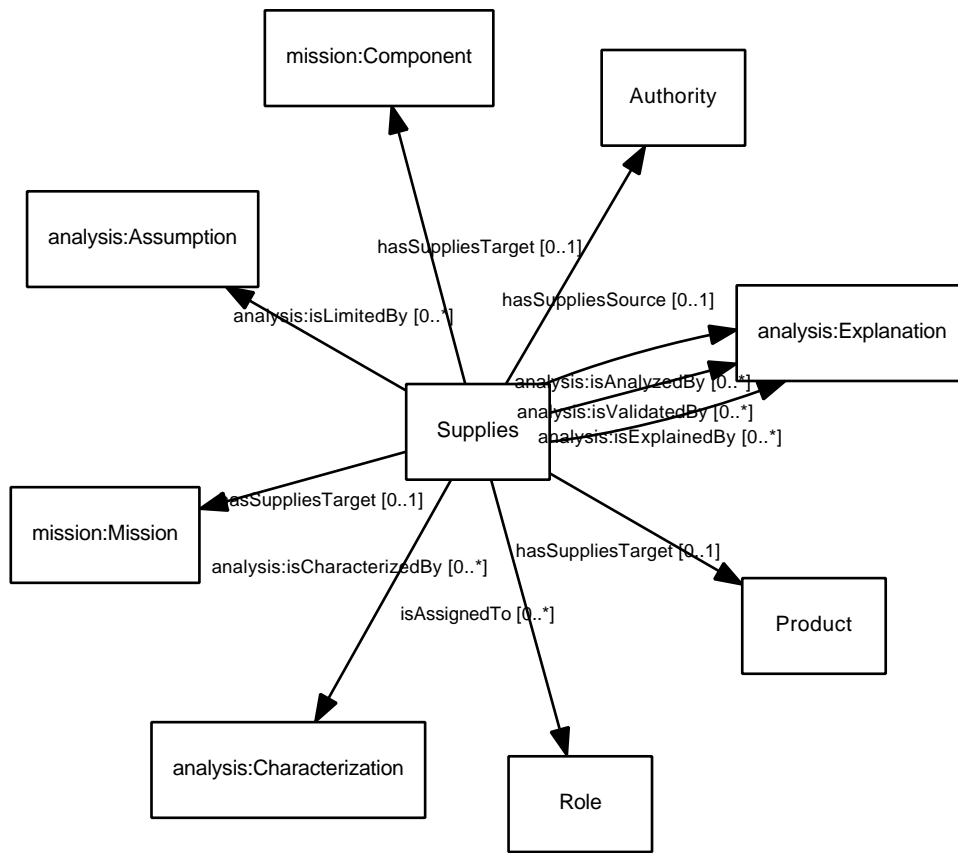


Figure 86: Class usage diagram for Supplies.

7 Concrete Datatype Property Definitions

7.1 isRequiredNotLaterThan

A *ScheduledElement* e *isRequiredNotLaterThan* d if and only if e must be completed or achieved no later than d .

Asserted Superproperties: project-backbone:topDataProperty

Domain: Deliverable

Range: [0..1] xsd:date

Derived: false

8 Abstract Object Property Definitions

8.1 involves

Inferred Superproperties: project-backbone:topObjectProperty, project-backbone:topReifiedObjectProperty

Range: [0..*] Process

Inverse: isInvolvedIn

Derived: false

Reification Class: Involves

Reification Property Chain: hasInvolvesSource⁻¹ o hasInvolvesTarget

8.2 isInvolvedIn

Inferred Superproperties: project-backbone:topObjectProperty, project-backbone:topReifiedObjectProperty

Range: [0..*] Interchange

Inverse: involves

Derived: true

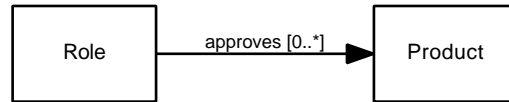


Figure 87: Property usage diagram for approves.

9 Concrete Object Property Definitions

9.1 approves

Asserted Superproperties: hasAssignment

Inferred Superproperties: project-backbone:topObjectProperty, project-backbone:topReifiedObjectProperty

Domain: Role

Range: [0..*] Product

Inverse: isApprovedBy

Derived: false

Reification Class: Approves

Reification Property Chain: hasApprovesSource⁻¹ ◦ hasApprovesTarget

The property usage diagram for approves is shown in Figure 87.

9.2 authorizes

Asserted Superproperties: project-backbone:topReifiedObjectProperty

Inferred Superproperties: project-backbone:topObjectProperty

Domain: Authority

Range: [0..*] Authority

Derived: false

Reification Class: Authorizes

Reification Property Chain: hasAuthorizesSource⁻¹ ◦ hasAuthorizesTarget

The property usage diagram for authorizes is shown in Figure 88.

9.3 belongsTo

A Person belongsTo zero or more Organizations.

Asserted Superproperties: project-backbone:topReifiedObjectProperty

Inferred Superproperties: project-backbone:topObjectProperty

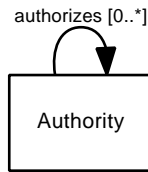


Figure 88: Property usage diagram for authorizes.

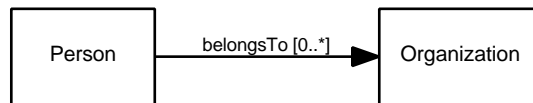


Figure 89: Property usage diagram for belongsTo.

Domain: Person**Range:** [0..*] Organization**Derived:** false**Reification Class:** BelongsTo**Reification Property Chain:** hasBelongsToSource⁻¹ ◦ hasBelongsToTarget

The property usage diagram for belongsTo is shown in Figure 89.

9.4 binds

A *Policy p* binds a *SpecifiedElement e* if and only if the course of action embodied in *p* governs the design, analysis, implementation, operation, or other applicable aspects of *e*.

Asserted Superproperties: project-backbone:topReifiedObjectProperty**Inferred Superproperties:** project-backbone:topObjectProperty**Domain:** Policy**Range:** [0..*] mission:SpecifiedElement**Inverse:** isBoundBy**Derived:** false**Reification Class:** Binds**Reification Property Chain:** hasBindsSource⁻¹ ◦ hasBindsTarget

The property usage diagram for binds is shown in Figure 90.

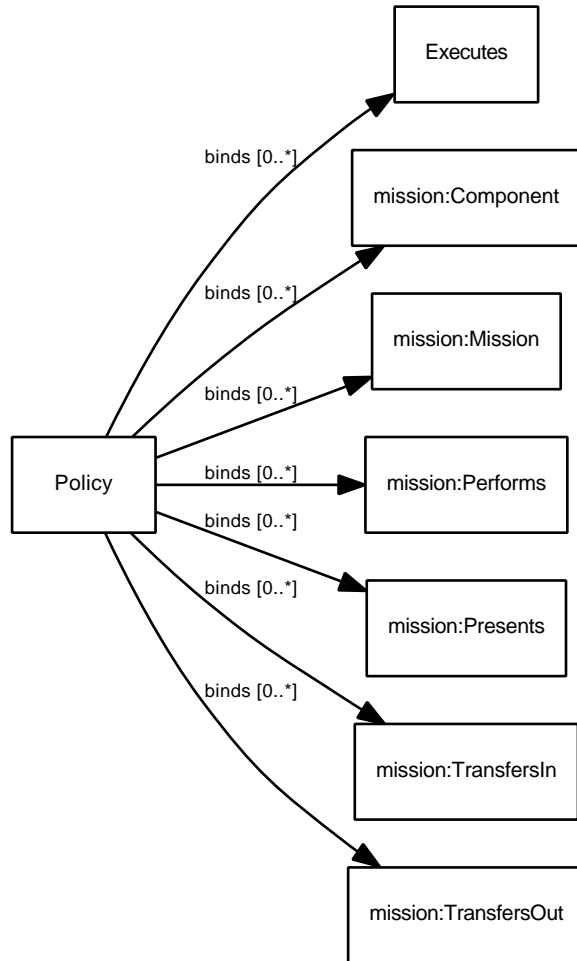


Figure 90: Property usage diagram for binds.

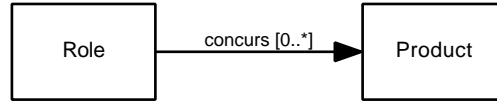


Figure 91: Property usage diagram for concurs.

9.5 concurs

Asserted Superproperties: hasAssignment

Inferred Superproperties: project-backbone:topObjectProperty, project-backbone:topReifiedObjectProperty

Domain: Role

Range: [0..*] Product

Inverse: isConcurredBy

Derived: false

Reification Class: Concurs

Reification Property Chain: hasConcursSource⁻¹ ◦ hasConcursTarget

The property usage diagram for concurs is shown in Figure 91.

9.6 delegatesTo

A Role r_1 delegatesTo a Role r_2 if and only if r_1 gives direction or otherwise exercises authority over r_2 .

Asserted Superproperties: project-backbone:topReifiedObjectProperty

Inferred Superproperties: project-backbone:topObjectProperty

Domain: Role

Range: [0..*] Role

Inverse: isDelegateOf

Derived: false

Reification Class: DelegatesTo

Reification Property Chain: hasDelegatesToSource⁻¹ ◦ hasDelegatesToTarget

The property usage diagram for delegatesTo is shown in Figure 92.

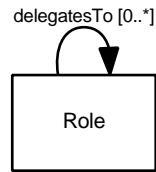


Figure 92: Property usage diagram for delegatesTo.

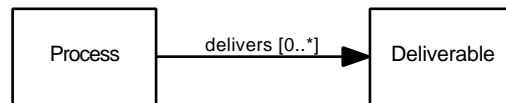


Figure 93: Property usage diagram for delivers.

9.7 delivers

A *Process* p delivers a *Deliverable* r if and only if the successful execution of p results in availability of r .

Asserted Superproperties: project-backbone:topReifiedObjectProperty

Inferred Superproperties: project-backbone:topObjectProperty

Domain: Process

Range: [0..*] Deliverable

Inverse: isDeliveredBy

Derived: false

Reification Class: Delivers

Reification Property Chain: hasDeliversSource⁻¹ o hasDeliversTarget

The property usage diagram for delivers is shown in Figure 93.

9.8 describes

A *Product* p describes a *DevelopmentElement* e if and only if p contains design, analysis, operations, or other information about e .

Asserted Superproperties: project-backbone:topReifiedObjectProperty

Inferred Superproperties: project-backbone:topObjectProperty

Domain: Product

Range: [0..*] DevelopedElement

Inverse: isDescribedBy

Derived: false

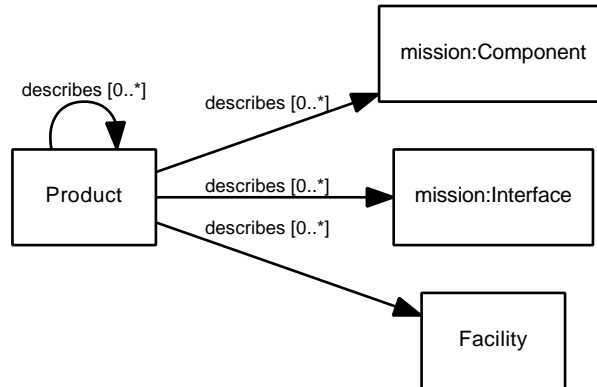


Figure 94: Property usage diagram for describes.

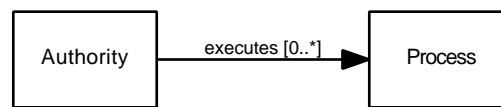


Figure 95: Property usage diagram for executes.

Reification Class: Describes

Reification Property Chain: hasDescribesSource⁻¹ ◦ hasDescribesTarget

The property usage diagram for describes is shown in Figure 94.

9.9 executes

An *Authority* a *executes* a *Process* p if and only if a carries out any actions required for successful completion of p .

Asserted Superproperties: project-backbone:topReifiedObjectProperty

Inferred Superproperties: project-backbone:topObjectProperty

Domain: Authority

Range: [0..*] Process

Inverse: isExecutedBy

Derived: false

Reification Class: Executes

Reification Property Chain: hasExecutesSource⁻¹ ◦ hasExecutesTarget

The property usage diagram for executes is shown in Figure 95.

9.10 hasAssignment

A *Role* r *hasAssignment* some *AssignedElement* e if and only if r has specific cognizance and/or responsibility for e .

Asserted Superproperties: project-backbone:topReifiedObjectProperty

Inferred Superproperties: project-backbone:topObjectProperty

Domain: Role

Range: [0..*] AssignedElement

Inverse: isAssignedTo

Derived: false

Reification Class: HasAssignment

Reification Property Chain: hasHasAssignmentSource⁻¹ ◦ hasHasAssignmentTarget

The property usage diagram for *hasAssignment* is shown in Figure 96.

9.11 hasParticipant

Asserted Superproperties: project-backbone:topReifiedObjectProperty

Inferred Superproperties: project-backbone:topObjectProperty

Domain: Interchange

Range: [0..*] Deliverable

Inverse: participatesIn

Derived: false

Reification Class: HasParticipant

Reification Property Chain: hasHasParticipantSource⁻¹ ◦ hasHasParticipantTarget

The property usage diagram for *hasParticipant* is shown in Figure 97.

9.12 hasResponsibilityFor

An *Organization* o *hasResponsibilityFor* some *Authority* a if and only if o provides the actual workforce and execution of the work embodied in a . An example is the relation between a “doing” *Organization* and a *WorkPackage*.

Asserted Superproperties: project-backbone:topReifiedObjectProperty

Inferred Superproperties: project-backbone:topObjectProperty

Domain: Organization

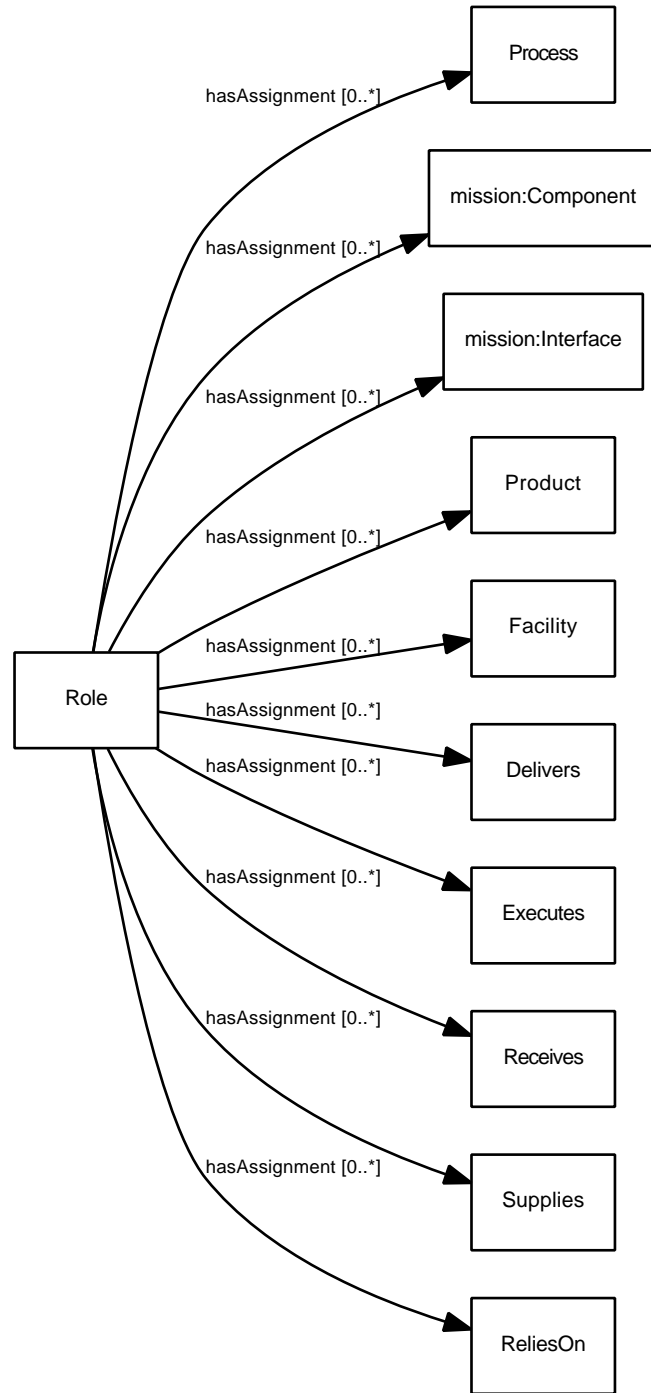


Figure 96: Property usage diagram for hasAssignment.

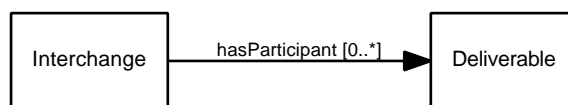


Figure 97: Property usage diagram for hasParticipant.

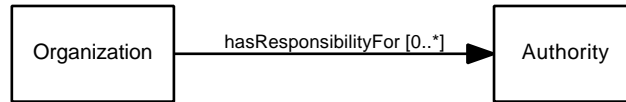


Figure 98: Property usage diagram for hasResponsibilityFor.

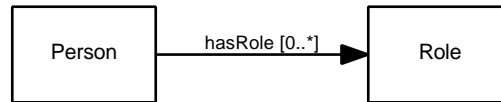


Figure 99: Property usage diagram for hasRole.

Range: [0..*] Authority

Inverse: isResponsibilityOf

Derived: false

Reification Class: HasResponsibilityFor

Reification Property Chain: hasHasResponsibilityForSource⁻¹ ◦ hasHasResponsibilityForTarget

The property usage diagram for hasResponsibilityFor is shown in Figure 98.

9.13 *hasRole*

A *Person* p *hasRole* *Role* r if and only if p acts to execute the assignments of r .

Asserted Superproperties: project-backbone:topReifiedObjectProperty

Inferred Superproperties: project-backbone:topObjectProperty

Domain: Person

Range: [0..*] Role

Inverse: isRoleOf

Derived: false

Reification Class: HasRole

Reification Property Chain: hasHasRoleSource⁻¹ ◦ hasHasRoleTarget

The property usage diagram for hasRole is shown in Figure 99.

9.14 *invokes*

A *PerformedElement* p *invokes* a *PerformedElement* c if and only if the execution of c may be triggered or caused by and within the execution of p .

Asserted Superproperties: project-backbone:topReifiedObjectProperty

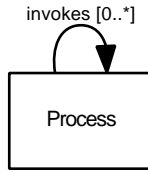


Figure 100: Property usage diagram for invokes.

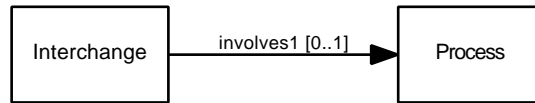


Figure 101: Property usage diagram for involves1.

Inferred Superproperties: project-backbone:topObjectProperty

Domain: Process

Range: [0..*] Process

Inverse: isInvokedBy

Derived: false

Reification Class: Invokes

Reification Property Chain: hasInvokesSource⁻¹ ◦ hasInvokesTarget

The property usage diagram for invokes is shown in Figure 100.

9.15 involves1

Asserted Superproperties: involves

Inferred Superproperties: project-backbone:topObjectProperty, project-backbone:topReifiedObjectProperty

Domain: Interchange

Range: [0..1] Process

Inverse: isInvolvedIn1

Derived: false

Reification Class: Involves1

Reification Property Chain: hasInvolves1Source⁻¹ ◦ hasInvolves1Target

The property usage diagram for involves1 is shown in Figure 101.

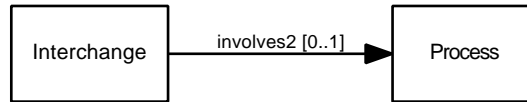


Figure 102: Property usage diagram for involves2.



Figure 103: Property usage diagram for isApprovedBy.

9.16 involves2

Asserted Superproperties: involves

Inferred Superproperties: project-backbone:topObjectProperty, project-backbone:topReifiedObjectProperty

Domain: Interchange

Range: [0..1] Process

Inverse: isInvolvedIn2

Derived: false

Reification Class: Involves2

Reification Property Chain: hasInvolves2Source⁻¹ o hasInvolves2Target

The property usage diagram for involves2 is shown in Figure 102.

9.17 isApprovedBy

Asserted Superproperties: isAssignedTo

Inferred Superproperties: project-backbone:topObjectProperty, project-backbone:topReifiedObjectProperty

Domain: Product

Range: [0..*] Role

Inverse: approves

Derived: true

The property usage diagram for isApprovedBy is shown in Figure 103.

9.18 isAssignedTo

See *hasAssignment*.

Asserted Superproperties: project-backbone:topReifiedObjectProperty

Inferred Superproperties: project-backbone:topObjectProperty

Domain: AssignedElement

Range: [0..*] Role

Inverse: hasAssignment

Derived: true

The property usage diagram for *isAssignedTo* is shown in Figure 104.

9.19 isBoundBy

See *binds*.

Asserted Superproperties: project-backbone:topReifiedObjectProperty

Inferred Superproperties: project-backbone:topObjectProperty

Domain: mission:SpecifiedElement

Range: [0..*] Policy

Inverse: binds

Derived: true

The property usage diagram for *isBoundBy* is shown in Figure 105.

9.20 isConcurredBy

Asserted Superproperties: isAssignedTo

Inferred Superproperties: project-backbone:topObjectProperty, project-backbone:topReifiedObjectProperty

Domain: Product

Range: [0..*] Role

Inverse: concurs

Derived: true

The property usage diagram for *isConcurredBy* is shown in Figure 106.

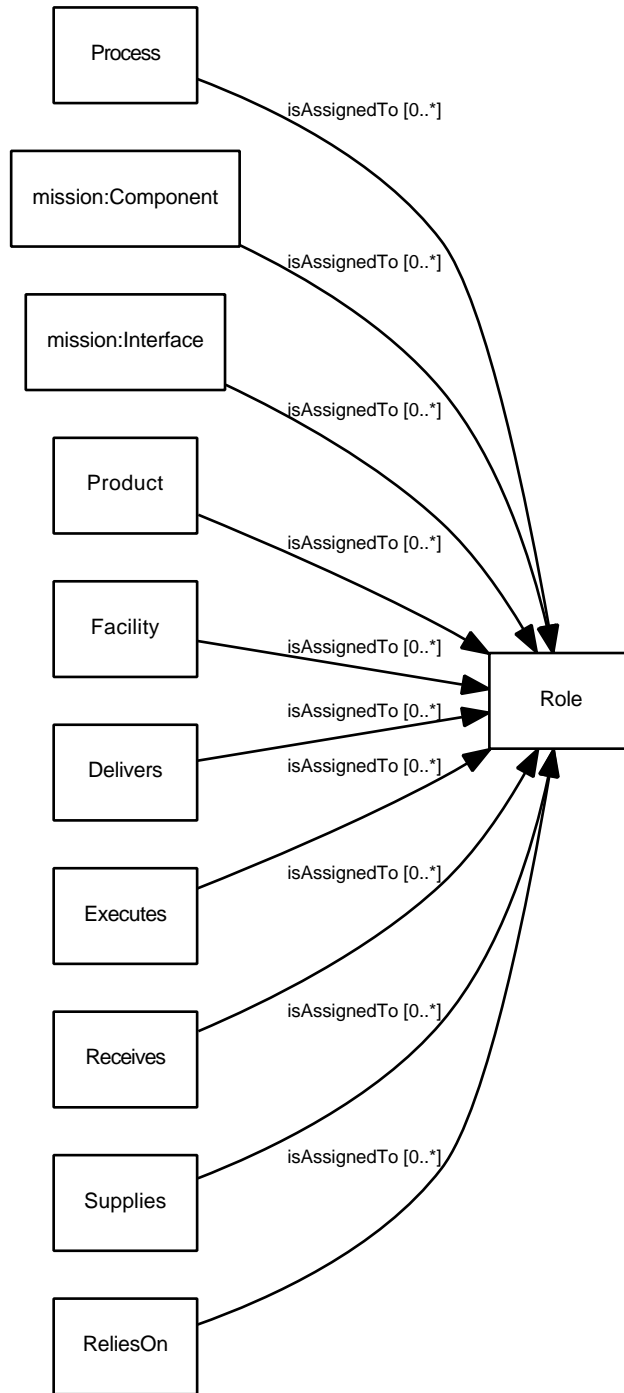
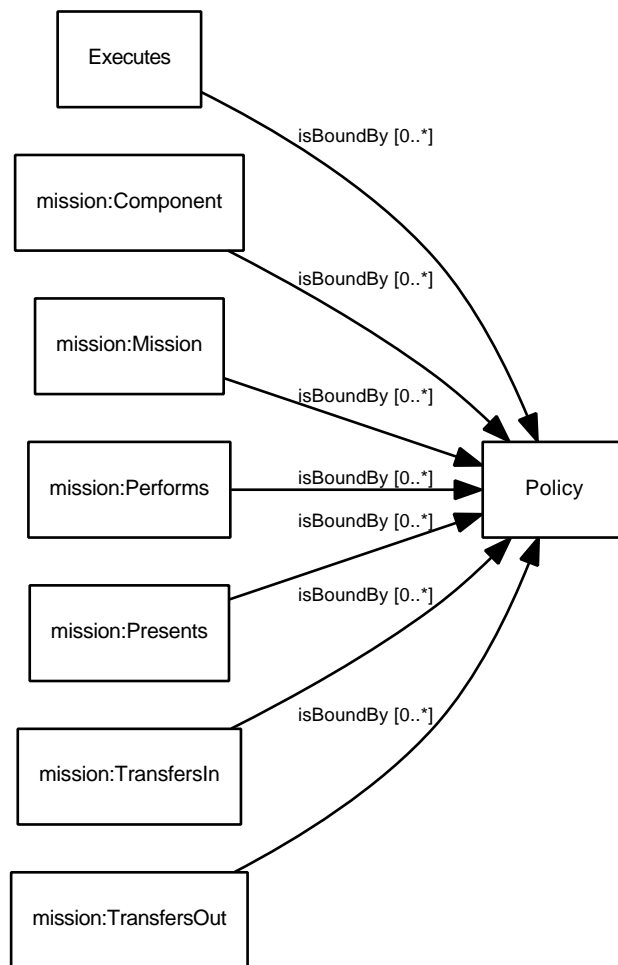
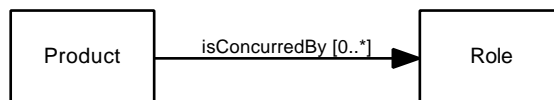
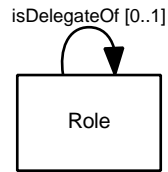
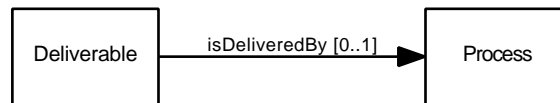


Figure 104: Property usage diagram for isAssignedTo.

Figure 105: Property usage diagram for `isBoundBy`.Figure 106: Property usage diagram for `isConcurredBy`.

Figure 107: Property usage diagram for *isDelegateOf*.Figure 108: Property usage diagram for *isDeliveredBy*.

9.21 *isDelegateOf*

See *delegatesTo*.

Asserted Superproperties: `project-backbone:topReifiedObjectProperty`

Inferred Superproperties: `project-backbone:topObjectProperty`

Domain: `Role`

Range: `[0..1] Role`

Inverse: `delegatesTo`

Derived: `true`

The property usage diagram for *isDelegateOf* is shown in Figure 107.

9.22 *isDeliveredBy*

See *delivers*.

Asserted Superproperties: `project-backbone:topReifiedObjectProperty`

Inferred Superproperties: `project-backbone:topObjectProperty`

Domain: `Deliverable`

Range: `[0..1] Process`

Inverse: `delivers`

Derived: `true`

The property usage diagram for *isDeliveredBy* is shown in Figure 108.

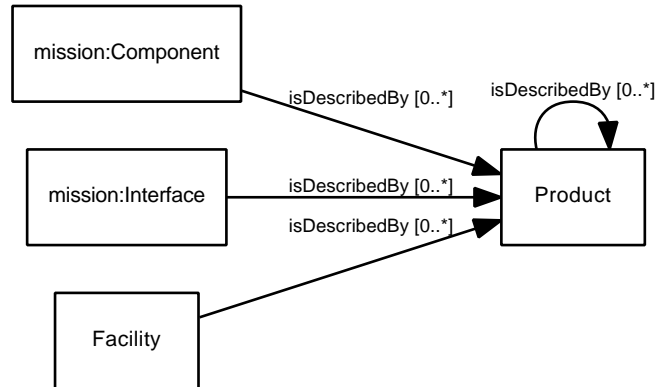


Figure 109: Property usage diagram for isDescribedBy.

9.23 isDescribedBy

See *describes*.

Asserted Superproperties: project-backbone:topReifiedObjectProperty

Inferred Superproperties: project-backbone:topObjectProperty

Domain: DevelopedElement

Range: [0..*] Product

Inverse: describes

Derived: true

The property usage diagram for isDescribedBy is shown in Figure 109.

9.24 isExecutedBy

See *executes*.

Asserted Superproperties: project-backbone:topReifiedObjectProperty

Inferred Superproperties: project-backbone:topObjectProperty

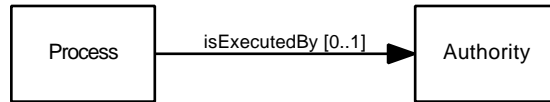
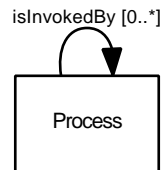
Domain: Process

Range: [0..1] Authority

Inverse: executes

Derived: true

The property usage diagram for isExecutedBy is shown in Figure 110.

Figure 110: Property usage diagram for *isExecutedBy*.Figure 111: Property usage diagram for *isInvokedBy*.

9.25 *isInvokedBy*

See *invokes*.

Asserted Superproperties: project-backbone:topReifiedObjectProperty

Inferred Superproperties: project-backbone:topObjectProperty

Domain: Process

Range: [0..*] Process

Inverse: *invokes*

Derived: true

The property usage diagram for *isInvokedBy* is shown in Figure 111.

9.26 *isInvolvedIn1*

Asserted Superproperties: *isInvolvedIn*

Inferred Superproperties: project-backbone:topObjectProperty, project-backbone:topReifiedObjectProperty

Domain: Process

Range: [0..*] Interchange

Inverse: *involves1*

Derived: true

The property usage diagram for *isInvolvedIn1* is shown in Figure 112.

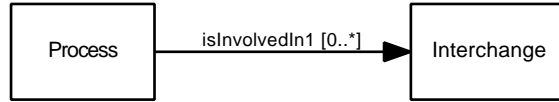


Figure 112: Property usage diagram for isInvolvedIn1.

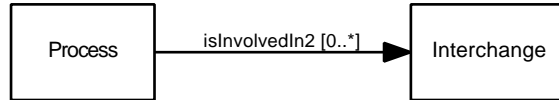


Figure 113: Property usage diagram for isInvolvedIn2.

9.27 isInvolvedIn2

Asserted Superproperties: isInvolvedIn

Inferred Superproperties: project-backbone:topObjectProperty, project-backbone:topReifiedObjectProperty

Domain: Process

Range: [0..*] Interchange

Inverse: involves2

Derived: true

The property usage diagram for isInvolvedIn2 is shown in Figure 113.

9.28 isManifestedBy

See *manifests*.

Asserted Superproperties: project-backbone:topReifiedObjectProperty

Inferred Superproperties: project-backbone:topObjectProperty

Domain: DevelopmentState

Range: [0..1] DevelopedElement

Inverse: manifests

Derived: true

The property usage diagram for isManifestedBy is shown in Figure 114.

9.29 isPreparedBy

Asserted Superproperties: isAssignedTo

Inferred Superproperties: project-backbone:topObjectProperty, project-backbone:topReifiedObjectProperty

Domain: Product

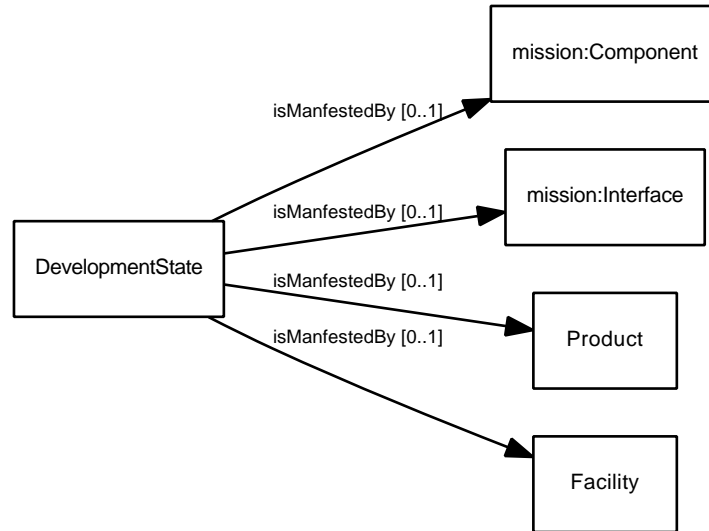


Figure 114: Property usage diagram for isManifestedBy.

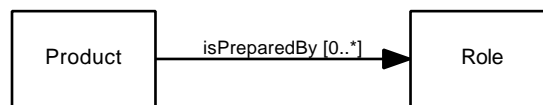


Figure 115: Property usage diagram for isPreparedBy.

Range: [0..*] Role

Inverse: prepares

Derived: true

The property usage diagram for isPreparedBy is shown in Figure 115.

9.30 isProducedBy

See *produces*.

Asserted Superproperties: isSuppliedBy

Inferred Superproperties: project-backbone:topObjectProperty, project-backbone:topReifiedObjectProperty

Domain: Product

Range: [0..1] Authority

Inverse: produces

Derived: true

The property usage diagram for isProducedBy is shown in Figure 116.

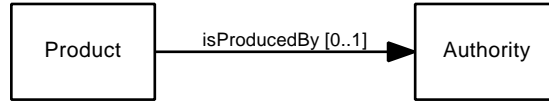


Figure 116: Property usage diagram for isProducedBy.

9.30.1 Comments

9.31 isRealizedBy

See *realizes*.

Asserted Superproperties: project-backbone:topReifiedObjectProperty

Inferred Superproperties: project-backbone:topObjectProperty

Domain: RealizedElement

Range: [0..*] RealizedElement

Inverse: realizes

Derived: true

The property usage diagram for isRealizedBy is shown in Figure 117.

9.32 isReceivedBy

See *receives*.

Asserted Superproperties: project-backbone:topReifiedObjectProperty

Inferred Superproperties: project-backbone:topObjectProperty

Domain: Deliverable

Range: [0..*] Process

Inverse: receives

Derived: true

The property usage diagram for isReceivedBy is shown in Figure 118.

9.33 isReliedOnBy

Asserted Superproperties: project-backbone:topReifiedObjectProperty

Inferred Superproperties: project-backbone:topObjectProperty

Domain: DevelopedElement

Range: [0..*] Authority

Inverse: reliesOn

Derived: true

The property usage diagram for isReliedOnBy is shown in Figure 119.

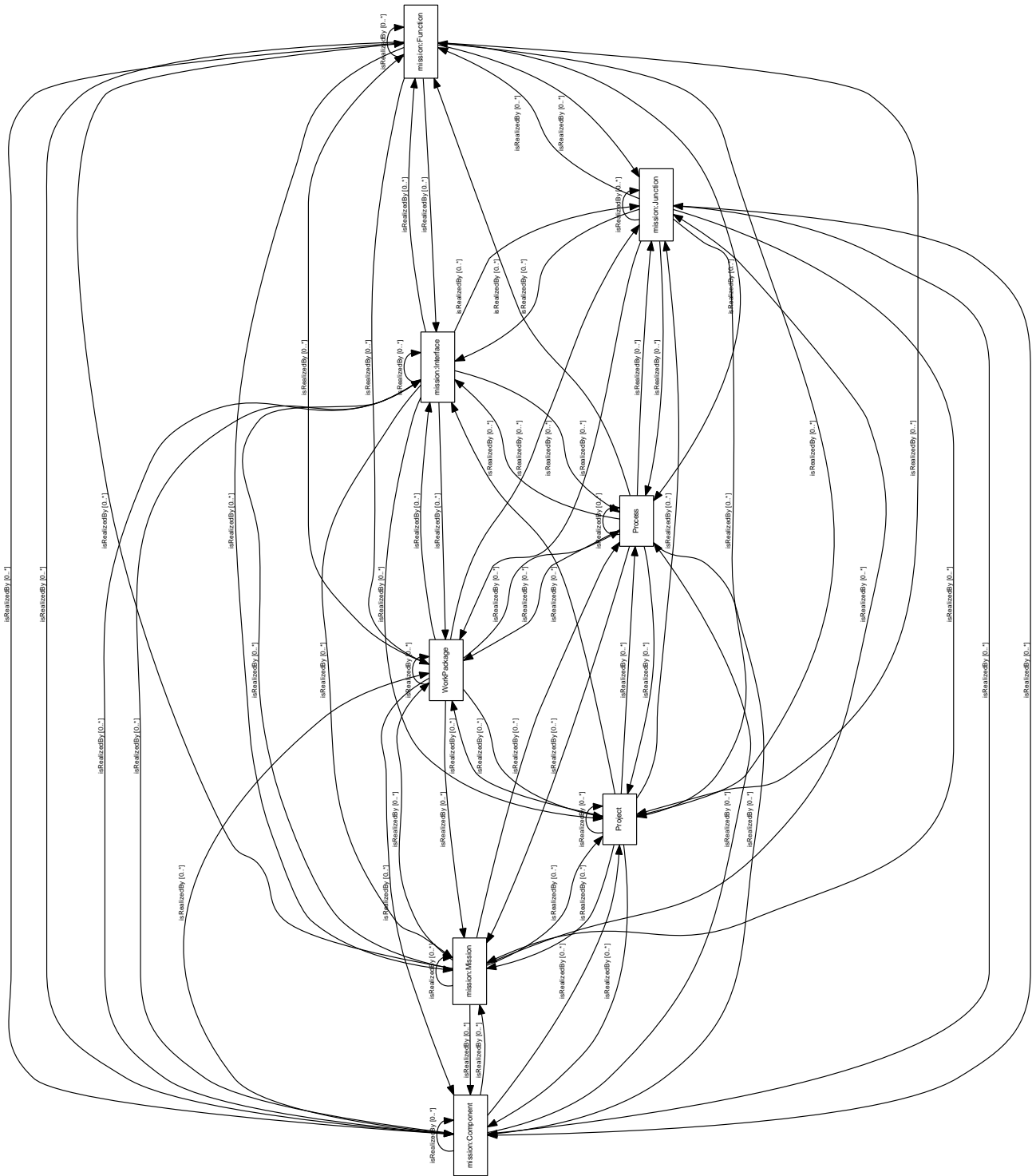


Figure 117: Property usage diagram for isRealizedBy.

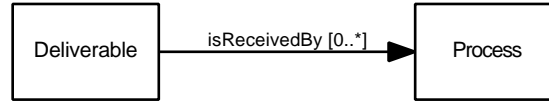


Figure 118: Property usage diagram for isReceivedBy.

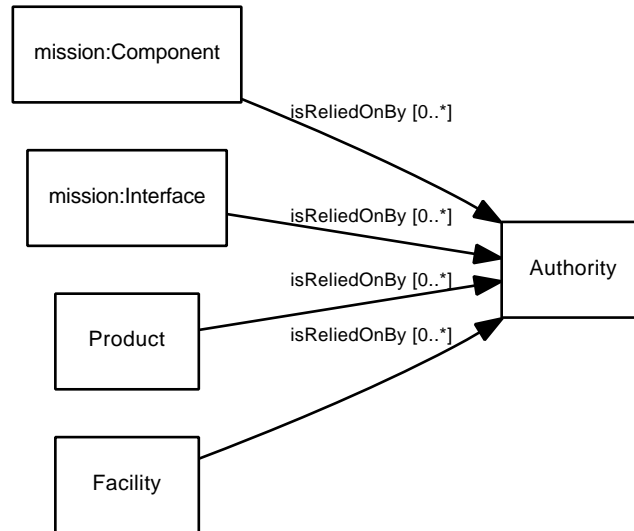


Figure 119: Property usage diagram for isReliedOnBy.

9.34 isRepresentedBy

See *represents*.

Asserted Superproperties: project-backbone:topReifiedObjectProperty

Inferred Superproperties: project-backbone:topObjectProperty

Domain: Concern

Range: [0..*] Stakeholder

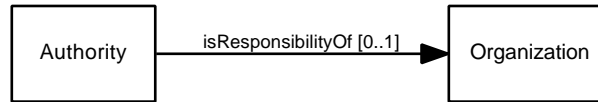
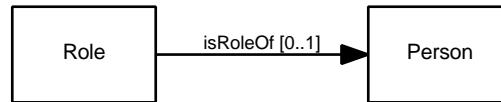
Inverse: represents

Derived: true

The property usage diagram for isRepresentedBy is shown in Figure 120.



Figure 120: Property usage diagram for isRepresentedBy.

Figure 121: Property usage diagram for *isResponsibilityOf*.Figure 122: Property usage diagram for *isRoleOf*.

9.35 *isResponsibilityOf*

See *hasResponsibilityFor*.

Asserted Superproperties: `project-backbone:topReifiedObjectProperty`

Inferred Superproperties: `project-backbone:topObjectProperty`

Domain: Authority

Range: [0..1] Organization

Inverse: *hasResponsibilityFor*

Derived: true

The property usage diagram for *isResponsibilityOf* is shown in Figure 121.

9.36 *isRoleOf*

See *hasRole*.

Asserted Superproperties: `project-backbone:topReifiedObjectProperty`

Inferred Superproperties: `project-backbone:topObjectProperty`

Domain: Role

Range: [0..1] Person

Inverse: *hasRole*

Derived: true

The property usage diagram for *isRoleOf* is shown in Figure 122.

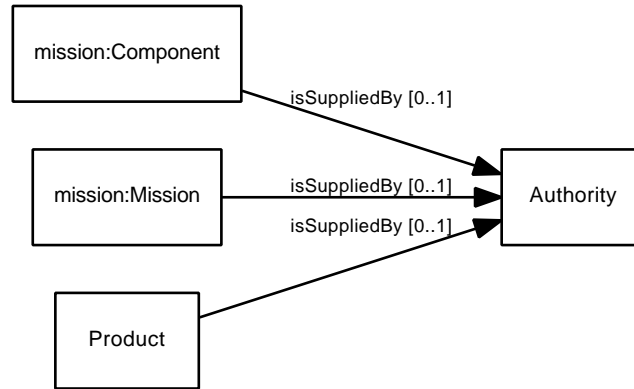


Figure 123: Property usage diagram for isSuppliedBy.

9.37 isSuppliedBy

See *supplies*.

Asserted Superproperties: project-backbone:topReifiedObjectProperty

Inferred Superproperties: project-backbone:topObjectProperty

Domain: SuppliedElement

Range: [0..1] Authority

Inverse: supplies

Derived: true

The property usage diagram for isSuppliedBy is shown in Figure 123.

9.38 manifests

A *DevelopmentalElement* e has *manifests* a *DevelopmentState* s if and only if e attains s during its development process.

Asserted Superproperties: project-backbone:topReifiedObjectProperty

Inferred Superproperties: project-backbone:topObjectProperty

Domain: DevelopedElement

Range: [0..*] DevelopmentState

Inverse: isManifestedBy

Derived: false

Reification Class: Manifests

Reification Property Chain: hasManifestsSource⁻¹ ◦ hasManifestsTarget

The property usage diagram for manifests is shown in Figure 124.

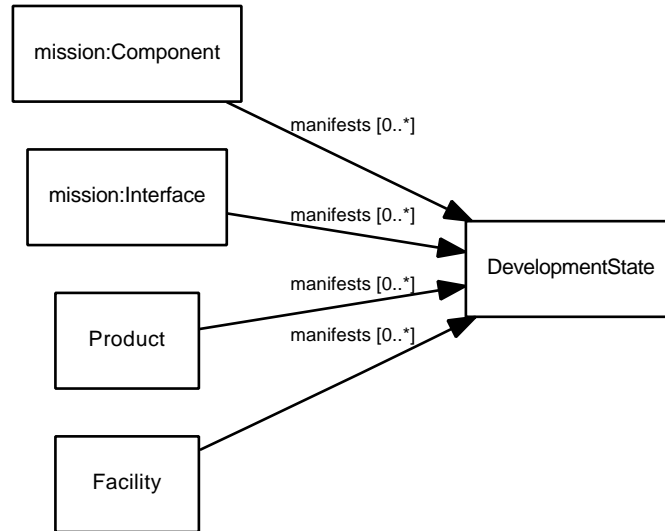


Figure 124: Property usage diagram for manifests.

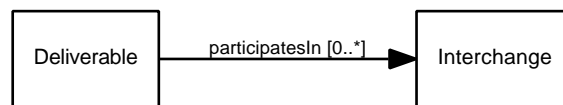


Figure 125: Property usage diagram for participatesIn.

9.39 *participatesIn*

Asserted Superproperties: project-backbone:topReifiedObjectProperty

Inferred Superproperties: project-backbone:topObjectProperty

Domain: Deliverable

Range: [0..*] Interchange

Inverse: hasParticipant

Derived: true

The property usage diagram for *participatesIn* is shown in Figure 125.

9.40 *prepares*

Asserted Superproperties: hasAssignment

Inferred Superproperties: project-backbone:topObjectProperty, project-backbone:topReifiedObjectProperty

Domain: Role

Range: [0..*] Product

Inverse: isPreparedBy

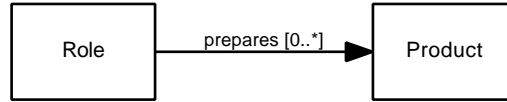


Figure 126: Property usage diagram for prepares.

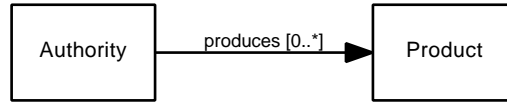


Figure 127: Property usage diagram for produces.

Derived: false

Reification Class: Prepares

Reification Property Chain: hasPreparesSource⁻¹ ◦ hasPreparesTarget

The property usage diagram for prepares is shown in Figure 126.

9.41 produces

A *WorkPackage* w produces a *Product* p if and only if w is responsible for creation and development of p .

Asserted Superproperties: supplies

Inferred Superproperties: project-backbone:topObjectProperty, project-backbone:topReifiedObjectProperty

Domain: Authority

Range: [0..*] Product

Inverse: isProducedBy

Derived: false

Reification Class: Produces

Reification Property Chain: hasProducesSource⁻¹ ◦ hasProducesTarget

The property usage diagram for produces is shown in Figure 127.

9.41.1 Comments

9.42 realizes

A *SpecifiedElement* c_1 realizes a *SpecifiedElement* c_2 if and only if c_1 is proffered by a supplier as a specification-compliant implementation of c_2 .

Asserted Superproperties: project-backbone:topReifiedObjectProperty

Inferred Superproperties: project-backbone:topObjectProperty

Domain: RealizedElement

Range: [0..*] RealizedElement

Inverse: isRealizedBy

Derived: false

Reification Class: Realizes

Reification Property Chain: hasRealizesSource⁻¹ ◦ hasRealizesTarget

The property usage diagram for realizes is shown in Figure 128.

9.43 receives

A Process p receives a Deliverable r if and only if the successful execution of *p* is contingent on the receipt of *r*.

Asserted Superproperties: project-backbone:topReifiedObjectProperty

Inferred Superproperties: project-backbone:topObjectProperty

Domain: Process

Range: [0..*] Deliverable

Inverse: isReceivedBy

Derived: false

Reification Class: Receives

Reification Property Chain: hasReceivesSource⁻¹ ◦ hasReceivesTarget

The property usage diagram for receives is shown in Figure 129.

9.44 reliesOn

Asserted Superproperties: project-backbone:topReifiedObjectProperty

Inferred Superproperties: project-backbone:topObjectProperty

Domain: Authority

Range: [0..*] DevelopedElement

Inverse: isReliedOnBy

Derived: false

Reification Class: ReliesOn

Reification Property Chain: hasReliesOnSource⁻¹ ◦ hasReliesOnTarget

The property usage diagram for reliesOn is shown in Figure 130.

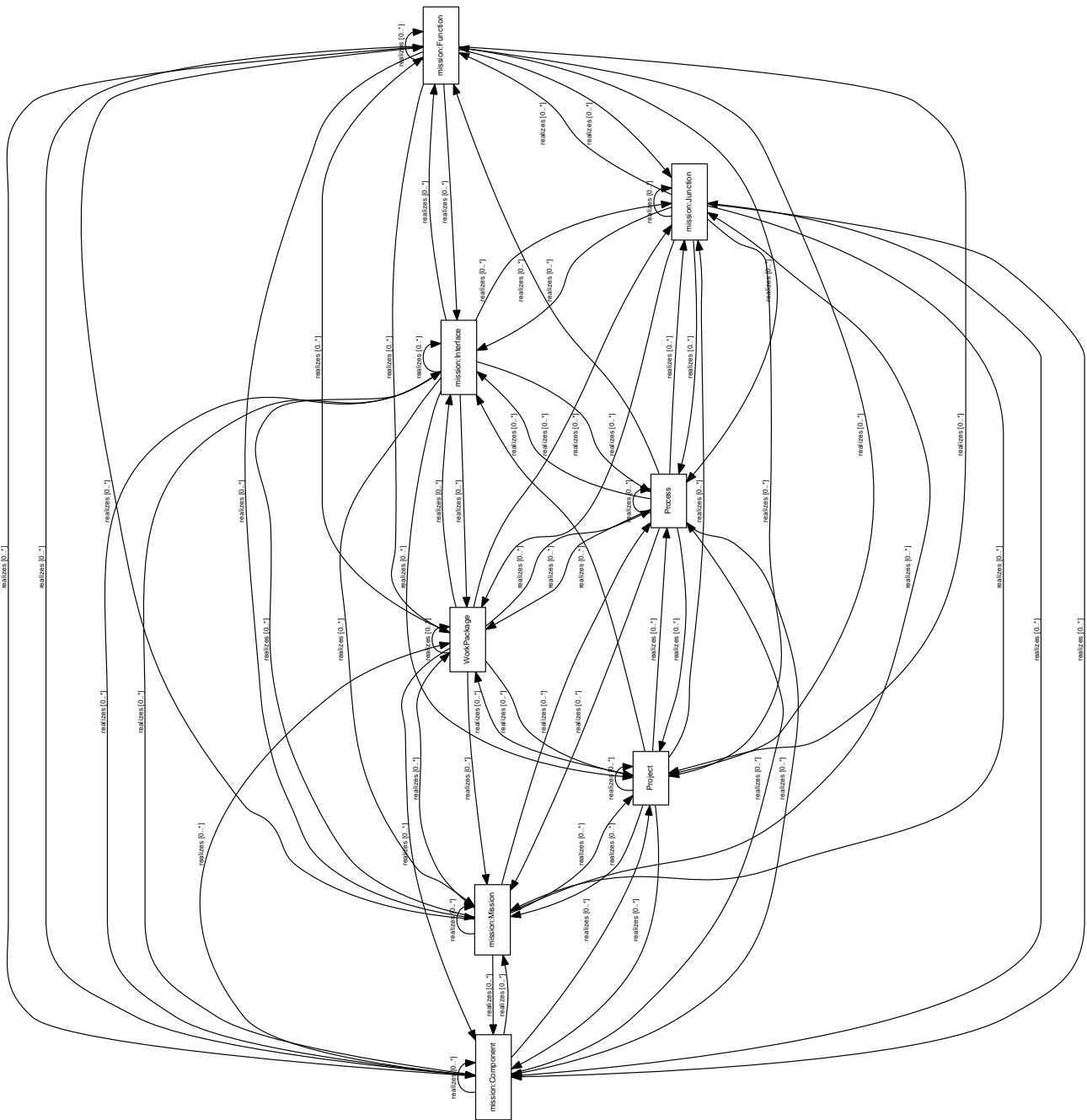


Figure 128: Property usage diagram for realizes.

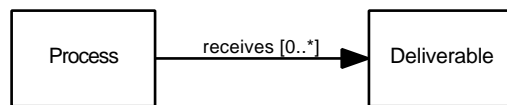


Figure 129: Property usage diagram for receives.

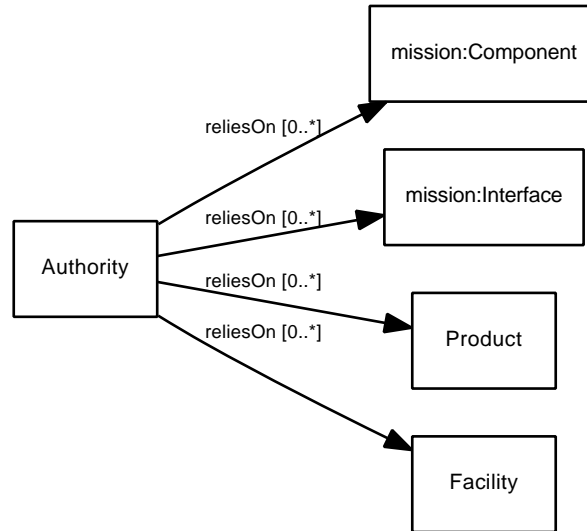


Figure 130: Property usage diagram for reliesOn.

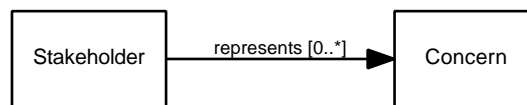


Figure 131: Property usage diagram for represents.

9.45 represents

A *Stakeholder* s represents *Concern* c if and only if s has a direct, legitimate, and recognized interest in c as it relates to a particular *Project* or *Program*.

Asserted Superproperties: project-backbone:topReifiedObjectProperty

Inferred Superproperties: project-backbone:topObjectProperty

Domain: Stakeholder

Range: [0..*] Concern

Inverse: isRepresentedBy

Derived: false

Reification Class: Represents

Reification Property Chain: hasRepresentsSource⁻¹ o hasRepresentsTarget

The property usage diagram for represents is shown in Figure 131.

9.46 supplies

A *WorkPackage* w supplies a *Component* c if and only if w is responsible for the acquisition and delivery of c .

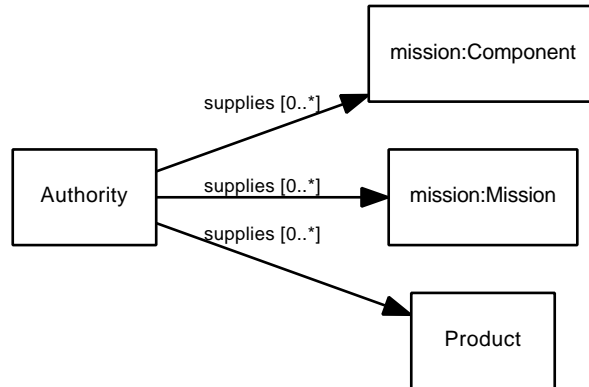


Figure 132: Property usage diagram for supplies.

Asserted Superproperties: project-backbone:topReifiedObjectProperty

Inferred Superproperties: project-backbone:topObjectProperty

Domain: Authority

Range: [0..*] SuppliedElement

Inverse: isSuppliedBy

Derived: false

Reification Class: Supplies

Reification Property Chain: hasSuppliesSource⁻¹ o hasSuppliesTarget

The property usage diagram for supplies is shown in Figure 132.

10 Object Property Reification Source/Target Object Property Definitions

10.1 hasApprovesSource

Asserted Superproperties: hasHasAssignmentSource

Inferred Superproperties: project-backbone:topObjectProperty,
project-backbone:topReifiedObjectPropertySource

Domain: Approves

Range: [0..1] Role

Derived: false

10.2 hasApprovesTarget

Asserted Superproperties: hasHasAssignmentTarget

Inferred Superproperties: project-backbone:topObjectProperty,
project-backbone:topReifiedObjectPropertyTarget

Domain: Approves

Range: [0..1] Product

Derived: false

10.3 hasAuthorizesSource

Asserted Superproperties: project-backbone:topReifiedObjectPropertySource

Inferred Superproperties: project-backbone:topObjectProperty

Domain: Authorizes

Range: [0..1] Authority

Derived: false

10.4 hasAuthorizesTarget

Asserted Superproperties: project-backbone:topReifiedObjectPropertyTarget

Inferred Superproperties: project-backbone:topObjectProperty

Domain: Authorizes

Range: [0..1] Authority

Derived: false

10.5 hasBelongsToSource

Asserted Superproperties: project-backbone:topReifiedObjectPropertySource

Inferred Superproperties: project-backbone:topObjectProperty

Domain: BelongsTo

Range: [0..1] Person

Derived: false

10.6 hasBelongsToTarget

Asserted Superproperties: project-backbone:topReifiedObjectPropertyTarget

Inferred Superproperties: project-backbone:topObjectProperty

Domain: BelongsTo

Range: [0..1] Organization

Derived: false

10.7 hasBindsSource

Asserted Superproperties: project-backbone:topReifiedObjectPropertySource

Inferred Superproperties: project-backbone:topObjectProperty

Domain: Binds

Range: [0..1] Policy

Derived: false

10.8 hasBindsTarget

Asserted Superproperties: project-backbone:topReifiedObjectPropertyTarget

Inferred Superproperties: project-backbone:topObjectProperty

Domain: Binds

Range: [0..1] mission:SpecifiedElement

Derived: false

10.9 hasConcursSource

Asserted Superproperties: hasHasAssignmentSource

Inferred Superproperties: project-backbone:topObjectProperty,
project-backbone:topReifiedObjectPropertySource

Domain: Concurs

Range: [0..1] Role

Derived: false

10.10 hasConcursTarget

Asserted Superproperties: hasHasAssignmentTarget

Inferred Superproperties: project-backbone:topObjectProperty,
project-backbone:topReifiedObjectPropertyTarget

Domain: Concurs

Range: [0..1] Product

Derived: false

10.11 hasDelegatesToSource

Asserted Superproperties: project-backbone:topReifiedObjectPropertySource

Inferred Superproperties: project-backbone:topObjectProperty

Domain: DelegatesTo

Range: [0..1] Role

Derived: false

10.12 hasDelegatesToTarget

Asserted Superproperties: project-backbone:topReifiedObjectPropertyTarget

Inferred Superproperties: project-backbone:topObjectProperty

Domain: DelegatesTo

Range: [0..1] Role

Derived: false

10.13 hasDeliversSource**Asserted Superproperties:** project-backbone:topReifiedObjectPropertySource**Inferred Superproperties:** project-backbone:topObjectProperty**Domain:** Delivers**Range:** [0..1] Process**Derived:** false**10.14 hasDeliversTarget****Asserted Superproperties:** project-backbone:topReifiedObjectPropertyTarget**Inferred Superproperties:** project-backbone:topObjectProperty**Domain:** Delivers**Range:** [0..1] Deliverable**Derived:** false**10.15 hasDescribesSource****Asserted Superproperties:** project-backbone:topReifiedObjectPropertySource**Inferred Superproperties:** project-backbone:topObjectProperty**Domain:** Describes**Range:** [0..1] Product**Derived:** false**10.16 hasDescribesTarget****Asserted Superproperties:** project-backbone:topReifiedObjectPropertyTarget**Inferred Superproperties:** project-backbone:topObjectProperty**Domain:** Describes**Range:** [0..1] DevelopedElement**Derived:** false**10.17 hasExecutesSource****Asserted Superproperties:** project-backbone:topReifiedObjectPropertySource**Inferred Superproperties:** project-backbone:topObjectProperty**Domain:** Executes**Range:** [0..1] Authority**Derived:** false

10.18 hasExecutesTarget

Asserted Superproperties: project-backbone:topReifiedObjectPropertyTarget

Inferred Superproperties: project-backbone:topObjectProperty

Domain: Executes

Range: [0..1] Process

Derived: false

10.19 hasHasAssignmentSource

Asserted Superproperties: project-backbone:topReifiedObjectPropertySource

Inferred Superproperties: project-backbone:topObjectProperty

Domain: HasAssignment

Range: [0..1] Role

Derived: false

10.20 hasHasAssignmentTarget

Asserted Superproperties: project-backbone:topReifiedObjectPropertyTarget

Inferred Superproperties: project-backbone:topObjectProperty

Domain: HasAssignment

Range: [0..1] AssignedElement

Derived: false

10.21 hasHasParticipantSource

Asserted Superproperties: project-backbone:topReifiedObjectPropertySource

Inferred Superproperties: project-backbone:topObjectProperty

Domain: HasParticipant

Range: [0..1] Interchange

Derived: false

10.22 hasHasParticipantTarget

Asserted Superproperties: project-backbone:topReifiedObjectPropertyTarget

Inferred Superproperties: project-backbone:topObjectProperty

Domain: HasParticipant

Range: [0..1] Deliverable

Derived: false

10.23 hasHasResponsibilityForSource**Asserted Superproperties:** project-backbone:topReifiedObjectPropertySource**Inferred Superproperties:** project-backbone:topObjectProperty**Domain:** HasResponsibilityFor**Range:** [0..1] Organization**Derived:** false**10.24 hasHasResponsibilityForTarget****Asserted Superproperties:** project-backbone:topReifiedObjectPropertyTarget**Inferred Superproperties:** project-backbone:topObjectProperty**Domain:** HasResponsibilityFor**Range:** [0..1] Authority**Derived:** false**10.25 hasHasRoleSource****Asserted Superproperties:** project-backbone:topReifiedObjectPropertySource**Inferred Superproperties:** project-backbone:topObjectProperty**Domain:** HasRole**Range:** [0..1] Person**Derived:** false**10.26 hasHasRoleTarget****Asserted Superproperties:** project-backbone:topReifiedObjectPropertyTarget**Inferred Superproperties:** project-backbone:topObjectProperty**Domain:** HasRole**Range:** [0..1] Role**Derived:** false**10.27 hasInvokesSource****Asserted Superproperties:** project-backbone:topReifiedObjectPropertySource**Inferred Superproperties:** project-backbone:topObjectProperty**Domain:** Invokes**Range:** [0..1] Process**Derived:** false

10.28 hasInvokesTarget

Asserted Superproperties: project-backbone:topReifiedObjectPropertyTarget

Inferred Superproperties: project-backbone:topObjectProperty

Domain: Invokes

Range: [0..1] Process

Derived: false

10.29 hasInvolves1Source

Asserted Superproperties: hasInvolvesSource

Inferred Superproperties: project-backbone:topObjectProperty,
project-backbone:topReifiedObjectPropertySource

Domain: Involves1

Range: [0..1] Interchange

Derived: false

10.30 hasInvolves1Target

Asserted Superproperties: hasInvolvesTarget

Inferred Superproperties: project-backbone:topObjectProperty,
project-backbone:topReifiedObjectPropertyTarget

Domain: Involves1

Range: [0..1] Process

Derived: false

10.31 hasInvolves2Source

Asserted Superproperties: hasInvolvesSource

Inferred Superproperties: project-backbone:topObjectProperty,
project-backbone:topReifiedObjectPropertySource

Domain: Involves2

Range: [0..1] Interchange

Derived: false

10.32 hasInvolves2Target

Asserted Superproperties: hasInvolvesTarget

Inferred Superproperties: project-backbone:topObjectProperty,
project-backbone:topReifiedObjectPropertyTarget

Domain: Involves2

Range: [0..1] Process

Derived: false

10.33 hasInvolvesSource

Asserted Superproperties: project-backbone:topReifiedObjectPropertySource

Inferred Superproperties: project-backbone:topObjectProperty

Domain: Involves

Range: [0..1] Interchange

Derived: false

10.34 hasInvolvesTarget

Asserted Superproperties: project-backbone:topReifiedObjectPropertyTarget

Inferred Superproperties: project-backbone:topObjectProperty

Domain: Involves

Range: [0..1] Process

Derived: false

10.35 hasManifestsSource

Asserted Superproperties: project-backbone:topReifiedObjectPropertySource

Inferred Superproperties: project-backbone:topObjectProperty

Domain: Manifests

Range: [0..1] DevelopedElement

Derived: false

10.36 hasManifestsTarget

Asserted Superproperties: project-backbone:topReifiedObjectPropertyTarget

Inferred Superproperties: project-backbone:topObjectProperty

Domain: Manifests

Range: [0..1] DevelopmentState

Derived: false

10.37 hasPreparesSource

Asserted Superproperties: hasHasAssignmentSource

Inferred Superproperties: project-backbone:topObjectProperty,
project-backbone:topReifiedObjectPropertySource

Domain: Prepares

Range: [0..1] Role

Derived: false

10.38 hasPreparesTarget

Asserted Superproperties: hasHasAssignmentTarget

Inferred Superproperties: project-backbone:topObjectProperty,
project-backbone:topReifiedObjectPropertyTarget

Domain: Prepares

Range: [0..1] Product

Derived: false

10.39 hasProducesSource

Asserted Superproperties: hasSuppliesSource

Inferred Superproperties: project-backbone:topObjectProperty,
project-backbone:topReifiedObjectPropertySource

Domain: Produces

Range: [0..1] Authority

Derived: false

10.40 hasProducesTarget

Asserted Superproperties: hasSuppliesTarget

Inferred Superproperties: project-backbone:topObjectProperty,
project-backbone:topReifiedObjectPropertyTarget

Domain: Produces

Range: [0..1] Product

Derived: false

10.41 hasRealizesSource

Asserted Superproperties: project-backbone:topReifiedObjectPropertySource

Inferred Superproperties: project-backbone:topObjectProperty

Domain: Realizes

Range: [0..1] RealizedElement

Derived: false

10.42 hasRealizesTarget

Asserted Superproperties: project-backbone:topReifiedObjectPropertyTarget

Inferred Superproperties: project-backbone:topObjectProperty

Domain: Realizes

Range: [0..1] RealizedElement

Derived: false

10.43 hasReceivesSource

Asserted Superproperties: project-backbone:topReifiedObjectPropertySource

Inferred Superproperties: project-backbone:topObjectProperty

Domain: Receives

Range: [0..1] Process

Derived: false

10.44 hasReceivesTarget

Asserted Superproperties: project-backbone:topReifiedObjectPropertyTarget

Inferred Superproperties: project-backbone:topObjectProperty

Domain: Receives

Range: [0..1] Deliverable

Derived: false

10.45 hasReliesOnSource

Asserted Superproperties: project-backbone:topReifiedObjectPropertySource

Inferred Superproperties: project-backbone:topObjectProperty

Domain: ReliesOn

Range: [0..1] Authority

Derived: false

10.46 hasReliesOnTarget

Asserted Superproperties: project-backbone:topReifiedObjectPropertyTarget

Inferred Superproperties: project-backbone:topObjectProperty

Domain: ReliesOn

Range: [0..1] DevelopedElement

Derived: false

10.47 hasRepresentsSource

Asserted Superproperties: project-backbone:topReifiedObjectPropertySource

Inferred Superproperties: project-backbone:topObjectProperty

Domain: Represents

Range: [0..1] Stakeholder

Derived: false

10.48 hasRepresentsTarget

Asserted Superproperties: project-backbone:topReifiedObjectPropertyTarget

Inferred Superproperties: project-backbone:topObjectProperty

Domain: Represents

Range: [0..1] Concern

Derived: false

10.49 hasSuppliesSource

Asserted Superproperties: project-backbone:topReifiedObjectPropertySource

Inferred Superproperties: project-backbone:topObjectProperty

Domain: Supplies

Range: [0..1] Authority

Derived: false

10.50 hasSuppliesTarget

Asserted Superproperties: project-backbone:topReifiedObjectPropertyTarget

Inferred Superproperties: project-backbone:topObjectProperty

Domain: Supplies

Range: [0..1] SuppliedElement

Derived: false

A UML/SysML Embedding

Table 1: Class UML/SysML Embedding

	SysML-metamodel:Class.Block	SysML-metamodel:Component.Block	UML-metamodel:Actor	UML-metamodel:AssociationClass	UML-metamodel:Class	UML-metamodel:Component	UML-metamodel:Package
AssignedElement							
Authority							•
Concern		•				•	
Deliverable	•				•		
DevelopedElement							
DevelopmentState	•				•		
Facility		•				•	
Interchange				•			
Organization		•				•	
Person		•				•	
Policy		•				•	
Process		•				•	
Product		•				•	
Program							•
Project							•
RealizedElement							
Role			•				
Stakeholder		•				•	
SuppliedElement							
WorkPackage							•

Table 2: Class OWL2-MOF2 Embedding

	owl2-mof2:BinaryAssociationEndType	owl2-mof2:BinaryDependencyEndType	owl2-mof2:ObjectPropertyDependentRangeType	owl2-mof2:StructuralFlowPropertyType
AssignedElement			•	
Authority		•		
Concern	•	•		
Deliverable		•		
DevelopedElement			•	
DevelopmentState		•		•
Facility	•	•		
Interchange			•	
Organization		•		
Person		•		
Policy			•	
Process		•		
Product	•	•		
Program		•		
Project		•		
RealizedElement			•	
Role		•		
Stakeholder		•		
SuppliedElement			•	
WorkPackage		•		

Table 3: Object Property Reification Class OWL2-MOF2 Embedding

	owl2-mof2-backbone:ReifiedObjectProperty	owl2-mof2:BinaryAssociation	owl2-mof2:BinaryAssociationBlockEnd	owl2-mof2:BinaryDependency	owl2-mof2:BinaryDependencyEndType	owl2-mof2:StructuralFlowPropertyRelationship
Approves				•	•	
Authorizes	•				•	
BelongsTo	•				•	
Binds	•				•	
Concurs				•	•	
DelegatesTo	•				•	
Delivers					•	•
Describes	•				•	
Executes	•				•	
HasAssignment	•				•	
HasParticipant					•	•
HasResponsibilityFor	•				•	
HasRole	•				•	
Invokes		•			•	
Involves	•				•	
Involves1			•		•	
Involves2			•		•	
Manifests		•			•	
Prepares				•	•	
Produces				•	•	
Realizes	•				•	
Receives					•	•
ReliesOn	•				•	
Represents	•				•	
Supplies	•				•	

Index

class

- analysis-backbone:Aspect, 15, 18, 21, 22, 24, 26, 27, 29, 32, 34, 35, 37, 39, 41, 43, 47, 49, 50, 52, 54, 58, 60, 62, 65, 66, 68, 70, 72, 73, 75, 78, 80, 81, 84
- analysis-backbone:Thing, 15, 18, 21, 22, 24, 26, 27, 29, 32, 34, 35, 37, 39, 41, 43, 47, 49, 50, 52, 54, 58, 60, 62, 65, 66, 68, 70, 72, 73, 75, 78, 80, 81, 84
- analysis:AnalyzedElement, 15, 18, 21, 22, 24, 26, 27, 29, 32, 34, 35, 37, 39, 41, 43, 47, 49, 50, 52, 54, 58, 60, 62, 65, 66, 68, 70, 72, 73, 75, 78, 80, 81, 84
- analysis:Assumption, 15, 18, 20, 22, 24, 26, 27, 29, 32, 34, 35, 37, 41, 43, 44, 47, 49, 50, 52, 54, 58, 60, 62, 65, 66, 68, 70, 72, 73, 75, 78, 80, 81, 84
- analysis:Characterization, 15, 18, 20, 22, 24, 26, 29, 32, 34, 35, 37, 41, 43, 44, 47, 49, 50, 52, 54, 58, 60, 62, 65, 66, 68, 70, 72, 73, 75, 78, 80, 81, 84
- analysis:CharacterizedElement, 15, 18, 21, 22, 24, 26, 27, 29, 32, 34, 35, 37, 39, 41, 43, 47, 49, 50, 52, 54, 58, 60, 62, 65, 66, 68, 70, 72, 73, 75, 78, 80, 81, 84
- analysis:Criterion, 18
- analysis:Explanation, 15, 18, 20–22, 24, 26, 27, 29, 32, 34, 35, 37, 41, 43, 44, 47, 49, 50, 52, 54, 58, 60, 62, 65, 66, 68, 70, 72, 73, 75, 78, 80, 81, 84
- analysis:MeasuredElement, 18
- analysis:Quantity, 60
- Approves, **47**, 60, 91, 121, 135
- AssignedElement, **9**, 9, 22, 32, 34, 39, 47, 52, 54, 58, 60, 75, 78, 80, 84, 97, 102, 125, 133, 134
- Authority, 9, 13, **15**, 15, 24, 26, 32, 34, 35, 37, 43, 44, 49, 58, 65, 75, 80, 84, 91, 96, 99, 106, 109, 110, 113, 114, 116, 117, 120, 121, 124, 126, 129, 131–134
- Authorizes, **47**, 91, 121, 135
- base-backbone:Aspect, 15, 18, 21, 22, 24, 27, 32, 34, 35, 37, 39, 41, 43
- base-backbone:Entity, 15, 35, 37, 43
- base-backbone:Thing, 15, 18, 21, 22, 24, 27, 32, 34, 35, 37, 39, 41, 43
- base:AggregatedElement, 18, 34
- base:IdentifiedElement, 15, 18, 21, 22, 24, 27, 32, 34, 35, 37, 39, 41, 43
- base:Package, 15, 35, 37, 43
- BelongsTo, **49**, 92, 122, 135
- Binds, **50**, 92, 122, 135
- Concern, **18**, 18, 43, 81, 112, 119, 131, 133, 134
- Concurs, **50**, 60, 94, 123, 135
- DelegatesTo, **52**, 94, 123, 135
- Deliverable, **18**, 21, 26, 32, 54, 62, 78, 87, 95, 97, 105, 110, 115, 117, 124, 125, 131, 133, 134
- Delivers, 9, **54**, 95, 124, 135
- Describes, **58**, 96, 124, 135
- DevelopedElement, **9**, 9, 15, 21, 22, 34, 35, 39, 44, 58, 72, 80, 95, 106, 108, 110, 114, 117, 124, 128, 131, 133, 134
- DevelopmentState, 9, 18, **21**, 24, 34, 72, 108, 114, 129, 133, 134
- Executes, 9, **58**, 96, 124, 125, 135
- Facility, 9, **22**, 133, 134
- HasAssignment, 47, 50, **60**, 73, 97, 125, 135
- HasParticipant, **62**, 97, 125, 135
- HasResponsibilityFor, **65**, 99, 126, 135
- HasRole, **65**, 99, 126, 135
- Interchange, 20, 22, **24**, 32, 62, 68, 70, 72, 89, 97, 100, 101, 107, 108, 115, 125, 127, 128, 133, 134
- Invokes, **66**, 100, 126, 127, 135
- Involves, **68**, 70, 89, 128, 135
- Involves1, 68, **70**, 100, 127, 135
- Involves2, 68, **70**, 101, 127, 128, 135
- Manifests, **72**, 114, 128, 129, 135
- mission-backbone:Aspect, 58
- mission-backbone:Thing, 58
- mission:Component, 9, 13, 44
- mission:Function, 9
- mission:Interface, 9
- mission:Junction, 9
- mission:Mission, 9, 13, 39
- mission:Objective, 18
- mission:Requirement, 60
- mission:SpecifiedElement, 29, 50, 58, 92, 102, 122
- Organization, 15, **26**, 27, 35, 39, 44, 49, 65, 92, 97, 113, 122, 126, 133, 134

- owl2-mof2-backbone:ReifiedObjectProperty, 135
- owl2-mof2:BinaryAssociation, 135
- owl2-mof2:BinaryAssociationBlockEnd, 135
- owl2-mof2:BinaryAssociationEndType, 134
- owl2-mof2:BinaryDependency, 135
- owl2-mof2:BinaryDependencyEndType, 134, 135
- owl2-mof2:ObjectPropertyDependentRangeType, 134
- owl2-mof2:StructuralFlowPropertyRelationship, 135
- owl2-mof2:StructuralFlowPropertyType, 134
- Person, **27**, 39, 49, 65, 92, 99, 113, 122, 126, 133, 134
- Policy, **29**, 50, 60, 92, 102, 122, 133, 134
- Prepares, 60, **73**, 116, 129, 135
- Process, 9, 15, 20, 22, 26, **32**, 32, 35, 37, 44, 54, 60, 66, 68, 70, 72, 78, 89, 95, 96, 100, 101, 105–108, 110, 117, 124–128, 130, 133, 134
- Produces, **75**, 84, 116, 129, 130, 135
- Product, 9, 13, 15, 24, **34**, 34, 35, 39, 41, 44, 47, 52, 58, 73, 75, 91, 94, 95, 101, 102, 106, 108, 109, 115, 116, 121, 123, 124, 129, 130, 133, 134
- Program, 15, **35**, 133, 134
- Project, 9, 15, **37**, 37, 39, 133, 134
- project-backbone:Aspect, 9, 13, 22, 32, 34, 37, 43, 54, 58, 75, 78, 80, 84
- project-backbone:Entity, 15, 18, 21, 22, 24, 26, 27, 29, 32, 34, 35, 37, 39, 41, 43
- project-backbone:ReifiedObjectProperty, 47, 49, 50, 52, 54, 58, 60, 62, 65, 66, 68, 70, 72, 73, 75, 78, 80, 81, 84
- project-backbone:Thing, 9, 13, 15, 18, 21, 22, 24, 26, 27, 29, 32, 34, 35, 37, 39, 41, 43, 47, 49, 50, 52, 54, 58, 60, 62, 65, 66, 68, 70, 72, 73, 75, 78, 80, 81, 84
- RealizedElement, **9**, 9, 32, 37, 43, 78, 110, 117, 130, 133, 134
- Realizes, **78**, 117, 130, 135
- Receives, 9, **78**, 117, 130, 131, 135
- ReliesOn, 9, **80**, 117, 131, 135
- Represents, **81**, 119, 131, 135
- Role, 9, 24, 29, 32, 34, **39**, 39, 47, 52, 54, 60, 65, 73, 75, 80, 84, 91, 94, 97, 99, 101, 102, 105, 109, 113, 115, 121, 123, 125, 126, 129, 133, 134
- Stakeholder, 18, **41**, 81, 112, 119, 131, 133, 134
- SuppliedElement, **13**, 15, 34, 37, 75, 84, 114, 120, 132–134
- Supplies, 9, 75, **84**, 120, 132, 135
- SysML-metamodel:Class.Block, 133
- SysML-metamodel:Component.Block, 133
- UML-metamodel:Actor, 133
- UML-metamodel:AssociationClass, 133
- UML-metamodel:Class, 133
- UML-metamodel:Component, 133
- UML-metamodel:Package, 133
- WorkPackage, 9, 15, **43**, 44, 133, 134
- datatype
 - xsd:date, 20, 21, 87
 - xsd:string, 15, 18, 20–22, 24, 26, 27, 32, 34, 35, 37, 39, 41, 43, 44
- datatype property
 - base:hasAlternateName, 15, 18, 20–22, 24, 27, 32, 34, 35, 37, 39, 41, 43
 - base:hasCanonicalName, 15, 18, 20–22, 24, 27, 32, 34, 35, 37, 39, 41, 43
 - base:hasDescription, 15, 18, 20–22, 24, 27, 32, 34, 35, 37, 39, 41, 43
 - base:hasIdentifier, 15, 18, 20–22, 24, 27, 32, 34, 35, 37, 39, 41, 43
 - base:hasIndexEntry, 15, 18, 20–22, 24, 27, 32, 34, 35, 37, 39, 41, 44
 - base:hasShortName, 15, 18, 20–22, 24, 27, 32, 34, 35, 37, 39, 41, 44
 - base:hasSortKey, 15, 18, 20, 21, 24, 27, 32, 34, 35, 37, 39, 43, 44
 - base:hasUuid, 15, 18, 20, 21, 24, 26, 27, 32, 34, 35, 37, 39, 43, 44
 - isRequiredNotLaterThan, 20, 21, **87**
 - project-backbone:topDataProperty, 87
- object property
 - analysis:isAnalyzedBy, 15, 18, 20, 21, 24, 26, 29, 32, 34, 35, 37, 41, 43, 44, 47, 49, 50, 52, 54, 58, 60, 62, 65, 66, 68, 70, 72, 73, 75, 78, 80, 81, 84
 - analysis:isCharacterizedBy, 15, 18, 20, 22, 24, 26, 29, 32, 34, 35, 37, 41, 43, 44, 47, 49, 50, 52, 54, 58, 60, 62, 65, 66, 68, 70, 72, 73, 75, 78, 80, 81, 84
 - analysis:isExplainedBy, 15, 18, 20, 22, 24, 26, 29, 32, 34, 35, 37, 41, 43, 44, 47, 49, 50, 52, 54, 58, 60, 62, 65, 66, 68, 70, 72, 73, 75, 78, 80, 81, 84

analysis:isLimitedBy, 15, 18, 20, 22, 24, 26, 27, 29, 32, 34, 35, 37, 41, 43, 44, 47, 49, 50, 52, 54, 58, 60, 62, 65, 66, 68, 70, 72, 73, 75, 78, 80, 81, 84
 analysis:isMeasuredBy, 18
 analysis:isQuantifiedBy, 60
 analysis:isValidatedBy, 15, 18, 20, 22, 24, 26, 27, 29, 32, 34, 35, 37, 41, 43, 44, 47, 49, 50, 52, 54, 58, 60, 62, 65, 66, 68, 70, 72, 73, 75, 78, 80, 81, 84
 approves, 39, 47, **91**, 101
 authorizes, 15, 35, 37, 44, 49, **91**
 base:aggregates, 18, 34
 base:isAggregatedIn, 18, 34
 belongsTo, 27, 50, **91**
 binds, 29, 50, **92**, 102
 concurs, 39, 52, **94**, 102
 delegatesTo, 39, 54, **94**, 105
 delivers, 32, 54, **95**, 105
 describes, 34, 58, **95**, 106
 executes, 15, 35, 37, 44, 60, **96**, 106
 hasApprovesSource, 47, 91, **121**
 hasApprovesTarget, 47, 91, **121**
 hasAssignment, 39, 62, 91, 94, **97**, 102, 115
 hasAuthorizesSource, 49, 91, **121**
 hasAuthorizesTarget, 49, 91, **121**
 hasBelongsToSource, 49, 92, **122**
 hasBelongsToTarget, 49, 92, **122**
 hasBindsSource, 50, 92, **122**
 hasBindsTarget, 50, 92, **122**
 hasConcursSource, 52, 94, **123**
 hasConcursTarget, 52, 94, **123**
 hasDelegatesToSource, 52, 94, **123**
 hasDelegatesToTarget, 52, 94, **123**
 hasDeliversSource, 54, 95, **124**
 hasDeliversTarget, 54, 95, **124**
 hasDescribesSource, 58, 96, **124**
 hasDescribesTarget, 58, 96, **124**
 hasExecutesSource, 58, 96, **124**
 hasExecutesTarget, 60, 96, **125**
 hasHasAssignmentSource, 47, 52, 60, 75, 97, 121, 123, **125**, 129
 hasHasAssignmentTarget, 47, 52, 60, 75, 97, 121, 123, **125**, 129
 hasHasParticipantSource, 62, 97, **125**
 hasHasParticipantTarget, 62, 97, **125**
 hasHasResponsibilityForSource, 65, 99, **126**
 hasHasResponsibilityForTarget, 65, 99, **126**
 hasHasRoleSource, 65, 99, **126**
 hasHasRoleTarget, 65, 99, **126**
 hasInvokesSource, 66, 100, **126**
 hasInvokesTarget, 66, 100, **127**
 hasInvolves1Source, 70, 100, **127**
 hasInvolves1Target, 70, 100, **127**
 hasInvolves2Source, 72, 101, **127**
 hasInvolves2Target, 72, 101, **128**
 hasInvolvesSource, 68, 70, 72, 89, 127, **128**
 hasInvolvesTarget, 68, 70, 72, 89, 127, **128**, 128
 hasManifestsSource, 72, 114, **128**
 hasManifestsTarget, 72, 114, **129**
 hasParticipant, 26, 62, **97**, 115
 hasPreparesSource, 73, 116, **129**
 hasPreparesTarget, 73, 116, **129**
 hasProducesSource, 75, 116, **129**
 hasProducesTarget, 75, 116, **130**
 hasRealizesSource, 78, 117, **130**
 hasRealizesTarget, 78, 117, **130**
 hasReceivesSource, 78, 117, **130**
 hasReceivesTarget, 78, 117, **131**
 hasReliesOnSource, 80, 117, **131**
 hasReliesOnTarget, 80, 117, **131**
 hasRepresentsSource, 81, 119, **131**
 hasRepresentsTarget, 81, 119, **131**
 hasResponsibilityFor, 26, 65, **97**, 113
 hasRole, 29, 66, **99**, 113
 hasSuppliesSource, 75, 84, 120, 129, **132**
 hasSuppliesTarget, 75, 84, 120, 130, **132**
 invokes, 32, 68, **99**, 107
 involves, 68, **89**, 89, 100, 101
 involves1, 26, 70, **100**, 107
 involves2, 26, 72, **101**, 108
 isApprovedBy, 34, 91, **101**
 isAssignedTo, 9, 24, 32, 34, 54, 60, 75, 80, 84, 97, 101, **102**, 102, 108
 isBoundBy, 60, 92, **102**
 isConcurredBy, 34, 94, **102**
 isDelegateOf, 39, 94, **105**
 isDeliveredBy, 20, 22, 95, **105**
 isDescribedBy, 9, 24, 34, 95, **106**
 isExecutedBy, 32, 96, **106**
 isInvokedBy, 32, 100, **107**
 isInvolvedIn, **89**, 89, 107, 108
 isInvolvedIn1, 32, 100, **107**
 isInvolvedIn2, 32, 101, **108**
 isManifestedBy, 21, **108**, 114
 isPreparedBy, 34, **108**, 115

isProducedBy, 34, **109**, 116
 isRealizedBy, 9, 32, 37, 44, **110**, 117
 isReceivedBy, 20, 22, **110**, 117
 isReliedOnBy, 9, 24, 34, **110**, 117
 isRepresentedBy, 18, **112**, 119
 isResponsibilityOf, 15, 35, 39, 44, 99, **113**
 isRoleOf, 39, 99, **113**
 isSuppliedBy, 13, 34, 109, **114**, 120
 manifests, 9, 24, 34, 73, 108, **114**
 mission:isSpecifiedBy, 60
 participatesIn, 20, 22, 97, **115**
 prepares, 41, 75, 109, **115**
 produces, 15, 35, 39, 44, 75, 109, **116**
 project-backbone:topObjectProperty, 89, 91, 92,
 94–97, 99–102, 105–110, 112–117, 119–132
 project-backbone:topReifiedObjectProperty, 89,
 91, 92, 94–97, 99–102, 105–110, 112–117,
 119, 120
 project-backbone:topReifiedObjectPropertySource,
 121–132
 project-backbone:topReifiedObjectPropertyTarget,
 121–132
 realizes, 9, 32, 39, 44, 78, 110, **116**
 receives, 32, 80, 110, **117**
 reliesOn, 15, 35, 39, 44, 81, 110, **117**
 represents, 43, 81, 112, **119**
 supplies, 15, 37, 39, 44, 84, 114, 116, **119**